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Fruit Notes

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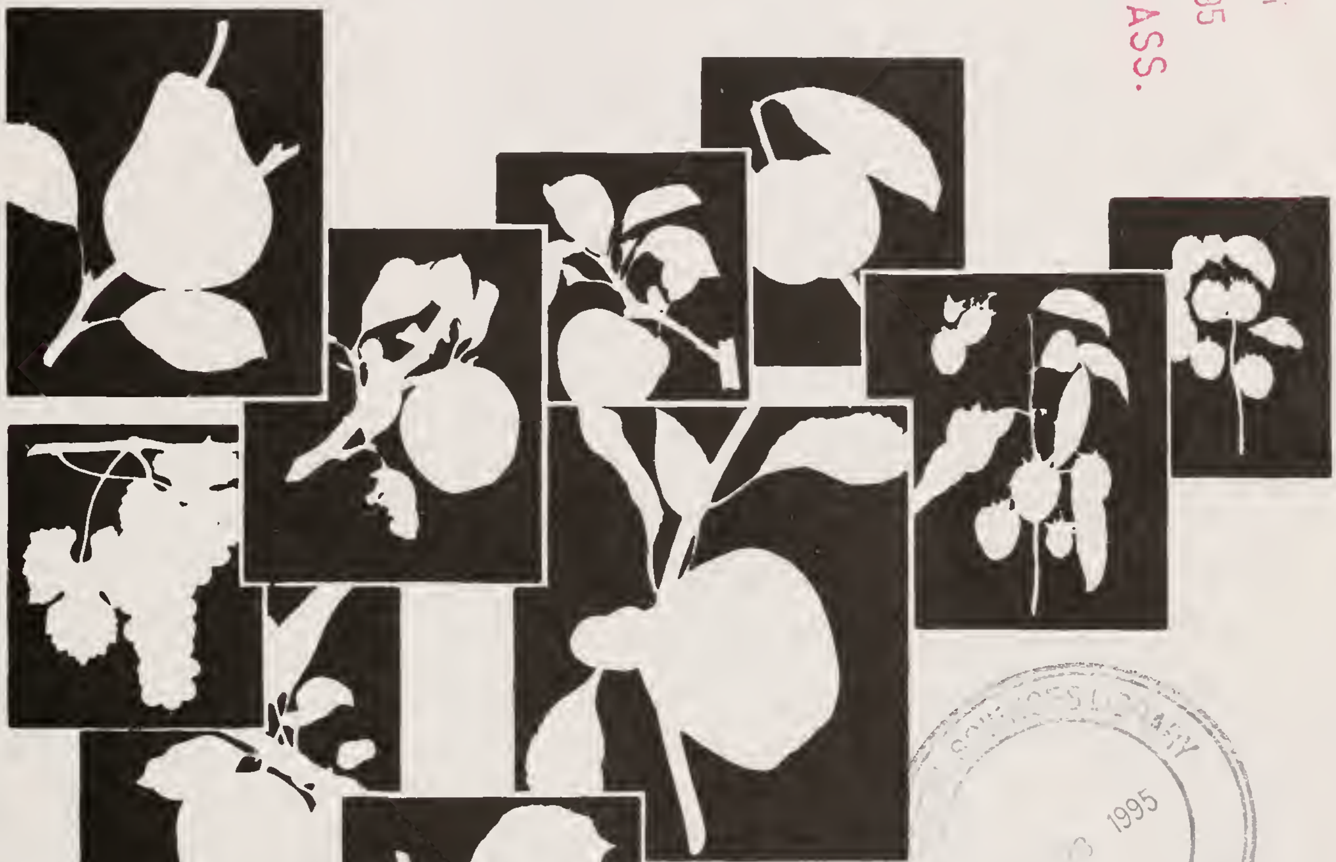

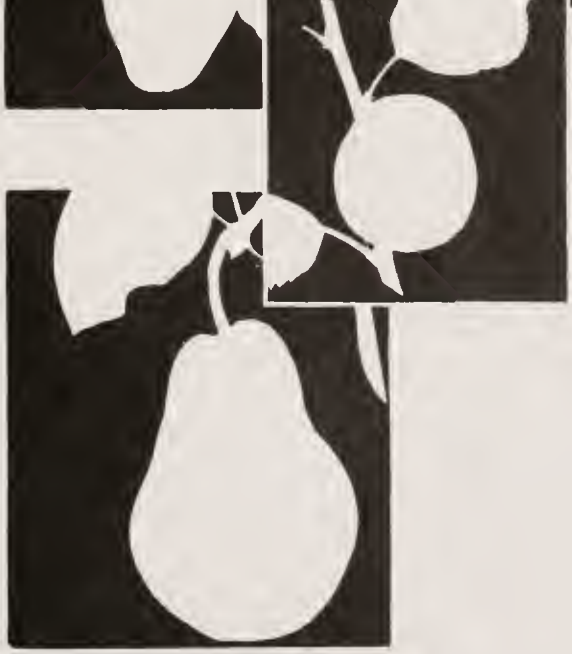

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COOPERATIVE EXTENSION SYSTEM POLICY:

Apple Integrated Pest Management in 1994: Insects and Mites in Second-level Orchard Blocks

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Since 1991, the Apple IPM program at the University of Massachusetts has been involved in a pilot project of second-level IPM in commercial Massachusetts apple orchards. Under second-level IPM, orchard management is integrated across all classes of pests: insects, mites, diseases, weeds, and vertebrates, rather than focusing on a single type of pest. Here we report results of the fourth and final year of this pilot project.

Insect and mite management under second-level IPM practices requires application of three to four selective insecticide sprays from April to early June to manage tarnished plant bug (TPB), European apple sawfly (EAS), plum curculio (PC), green fruitworm (GFW), and the first generations of codling moth (CM), lesser appleworm (LAW), apple blotch leafminer (ABLM), and white apple leafhopper (WALH). Insecticide application to the interior of the block ceases after the final plum curculio spray in early June, hopefully allowing populations of predatory insects and parasitoids to increase to levels sufficient to provide control of summer populations of foliar pests. In **full second-level IPM blocks**, apple maggot flies (AMF) are controlled by perimeter interception traps. In **transitional second-level IPM blocks**, use of AMF interception traps is replaced by perimeter-row spraying with Guthion™ or Imidan™ every three weeks beginning in early July. In both types of blocks, removal of unmanaged apple and pear trees within 100 yards of each block is intended to reduce immigration of CM and LAW. Removal of drops during and after harvest discourages buildup of within-orchard populations of AMF and CM.

It is our belief that in-depth studies of biologically based control methods, such as used in our second-level IPM pilot project, hold promise for apple growers facing the challenge of growing fruit in a manner that is both environmentally sound and financially feasible. Benefits could range from a more marketable fruit, due to decreased residue to slower development of insect resistance to pesticide. The main purpose of the pilot project has been to evaluate low-spray control methods to provide effective alternatives to Massachusetts apple growers.

In 1994, we continued work in the same six full second-level and five transitional second-level IPM test blocks used from 1991 to 1993. Each second-level block was matched with a nearby control block that was managed by the grower, using first-level IPM methods.

Early-Season Fruit-injuring Pests

For control of early season fruit-injuring pests active up to early June, second-level IPM is dependent on pesticide treatment based on monitoring. Orchards were monitored weekly beginning in mid-April and continuing through mid-June. Five white sticky rectangular traps were hung in early April in each block to monitor for TPB, and were rehung prior to bloom to monitor for EAS. During PC season, scouts examined fruit on perimeter trees for PC injury, but growers were advised to make daily inspections on their own. Recommendations for treatment of the experimental block were made to the grower on the basis of monitoring results.

Due to a lack of alternatives to pesticidal control of early-season fruit pests, first- and second-level blocks were managed similarly through early June, and therefore had similar insecticide use until that time (Table 1). Combined injury levels from early-season fruit pests at harvest in 1994 were similar in both first- and second-level blocks (full and transitional) (Table 2). TPB injury levels were lower than in 1993, while PC injury levels were higher, particularly in the transitional blocks. EAS levels were also greater than in 1993, although they remained lower than TPB and PC levels. Pesticide use was similar to 1993 in all block types.

Summer Fruit-injuring Pests: Full Second-level IPM

Odor-baited red sticky spheres were hung every five yards on perimeter apple trees of each full second-level block to intercept immigrating AMF. The spheres were baited with both butyl hexanoate, a synthetic fruit odor deployed in polyethylene vials, and ammonium carbonate,

Table 1. Dosage equivalents (spray events in parentheses) of insecticides and acaricides used in second-level and first-level IPM blocks in 1994.*

Type of block	Fruit pests: Before mid-June	Fruit pests: After mid-June	Mites: Oil	Mites: Other miticides	LH	ABLM	Total
Full second-level	2.6	0.0	1.6	0.0	0.5	0.4	5.1
	(3.2)	(0.0)	(2.3)	(0.0)	(0.7)	(0.5)	(6.7)
First-level	2.9	1.7	1.9	0.4	0.5	0.6	8.0
	(3.8)	(2.9)	(2.6)	(0.5)	(0.8)	(0.8)	(11.4)
Transitional second-level	3.0	0.4	1.8	0.0	0.0	0.0	5.2
	(3.1)	(0.8)	(2.8)	(0.0)	(0.0)	(0.0)	(6.7)
First-level	2.6	1.6	2.2	0.3	0.4	0.2	7.3
	(3.0)	(3.5)	(3.2)	(0.2)	(0.4)	(0.2)	(10.5)

* LH = leafhopper; ABLM = apple blotch leafminer.

Table 2. Average percent injury by early season insects pests in second-level and first-level IPM blocks in 1994*

Type of block	TPB	PC	EAS	GFW	Total
Full second-level	3.1a	0.6a	0.2a	0.1a	4.0a
First-level	3.4a	0.7a	0.6b	0.1a	4.8a
Transitional second-level	4.6a	1.9a	0.1a	0.1a	6.7a
First-level	2.6a	4.5a	0.3a	0.1a	7.5a

*Means in each couplet in each column followed by a different letter are significantly different at odds of 19:1. Two hundred fruit of each cultivar present in each second-level block were sampled at harvest in both second-level and first-level blocks. All blocks contained at least one of the following cultivars, and some contained up to four of these: McIntosh, Cortland, Delicious, Empire, Golden Delicious. Average number of fruit sampled per block = 500. When sampling a cultivar for early-season fruit pests, we examined 10 fruit on each of 20 interior trees. TPB = tarnished plant bug; PC = plum curculio; EAS = European apple sawfly; GFW = green fruitworm.

Table 3. Season-long apple maggot fly (AMF) injury and trap captures in second-level IPM blocks and first-level IPM blocks in 1994. *

Type of block	AMF injury to fruit at harvest (%)	Interior monitoring trap captures per four traps	Perimeter monitoring trap captures per four traps	Interception trap captures per block
Full second-level	4.2a	18.0a	38.1a	12,588
First-level	3.0a	9.8a	18.9a	-----
Transitional second-level	2.6a	8.9a	10.8a	-----
First-level	2.7a	7.4a	7.9a	-----

*Means in each couplet in each column followed by a different letter are significantly different at odds of 19:1. Two hundred fruit of each cultivar present in each second-level block were sampled at harvest in both second-level and first-level blocks. All blocks contained at least one of the following cultivars, and some contained up to four of these: McIntosh, Cortland, Delicious, Empire, Golden Delicious. Average number of fruit sampled per block = 500. When sampling a cultivar, we examined 10 fruit on each of 20 interior trees. An additional 10 fruit on each of 10 perimeter trees (when cultivar present on a perimeter row) were sampled for apple maggot fly and codling moth.

a synthetic food odor released through a small puncture in a foil wrapped package. Traps were cleaned every other week to maintain high capturing power.

Trap captures were up drastically from 1993 (and all previous years), with interception trap captures averaging 12,588 flies per full second-level block, as compared to 5023 in 1993. It should be noted, however, that approximately 60% of all AMF captured on perimeter traps in 1994 were captured in one orchard. Although the difference was not statistically significant, AMF captures on four interior unbaited monitoring traps were almost twice the number captured in nearby first-level blocks (Table 3). AMF injury in second-level blocks at harvest was considerably greater than in 1993, but was not significantly different from injury levels in first-level blocks (4.2 vs. 3.0%). While the higher interior trap captures were a concern, the relatively similar injury levels suggest the perimeter traps maintained a level of control fairly comparable to first-level blocks. Better trap positioning and an improved delivery system for food odor bait, as well as movement of the interception traps to later cultivars as earlier cultivars were harvested, may have aided the effectiveness of the trapping program.

While AMF injury levels among fruit on the trees at harvest were not a major concern, AMF levels in drops in several orchards were cause for concern. Some cultivars, especially Jersey Mac and Golden Delicious, had up to 50% AMF infestation in dropped fruit at harvest. It has been our policy to recommend immediate removal of drops after harvest, a policy that is difficult if not impossible to implement on many farms, given labor and time constraints. Research being conducted by a graduate student in our program suggests that even if all drops were to be removed immediately after harvest, such removal would have allowed considerable AMF larval emergence to have occurred before drop removal, because AMF larvae often leave fruit soon after it drops. It appears that cultivars susceptible to AMF could lead to infested drops and could cause difficulties in a second-level IPM management program by allowing within-orchard buildup of AMF.

Fruit injury by CM and LR was higher in second-level than in first-level blocks, and was higher in 1994 than in 1993 (Table 4). CM was considerably more evident in 1994 than in 1991-1993 and was a problem in a number of more traditionally-managed blocks across Massachusetts, as well as in second-level blocks. We feel that removal of abandoned host trees from within 100 yards of a second-level block provides good control of CM in average years. In years when CM are forced to travel farther distances due to limited wild host resources (as in 1994), however, tree removal may not be sufficient to protect a low-spray block. LR injury, while not much higher than 1993 levels, was significantly greater in second-level than in first level

Table 4. Fruit injury by codling moth (CM), leafroller (LR), and lesser appleworm (LAW) in second-level and first-level IPM blocks in 1994.*

Type of block	CM	LR	LAW
Full second-level	0.4a	1.0a	1.8a
First-level	0.1a	0.1b	0.2a
Transitional second-level	0.1a	0.1a	0.4a
First-level	0.0a	0.0a	0.0a

*Means in each couplet in each column followed by a different letter are significantly different at odds of 19:1. Two hundred fruit of each cultivar present in each second-level block were sampled at harvest in both second-level and first-level blocks. All blocks contained at least one of the following cultivars, and some contained up to four of these: McIntosh, Cortland, Delicious, Empire, Golden Delicious. Average number of fruit sampled per block = 500. When sampling a cultivar, we examined 10 fruit on each of 20 interior trees. An additional 10 fruit on each of 10 perimeter trees per cultivar (when cultivar present on a perimeter row) were sampled for apple maggot fly and codling moth.

blocks. Again, this observation suggests that lepidopteran pests may provide a special challenge in low-spray orchard situations.

LAW, a pest which first became a concern in 1993, was a major concern in one second-level block in 1994. The block had several rows of Cortlands bordered by a field of young trees and shrubs, and migration from the field toward the interior of the block seemed to have occurred. While the average of LAW injury in second-level blocks was not significantly higher than in first-level blocks, field observations suggested a direct link between low-spray management and fruit injury. In addition, Cortlands seem far more susceptible to LAW injury than McIntosh, as Cortland and McIntosh fruit in the same location have shown very different injury rates over the past two years. We plan to conduct research on LAW beginning in the summer of 1995.

No insecticide was applied against fruit-injuring pests after mid-June in second-level blocks. Growers applied an average of 1.7 dosage equivalents of insecticide against fruit pests after mid-June in first-level blocks, spraying such blocks an average of 2.9 times (Table 1).

Summer Fruit-injuring Pests: Transitional Second-level IPM

Every three weeks after early June, perimeter row apple trees in transitional second-level blocks were treated with insecticide to control AMF. The block interior remained free of insecticide directed toward fruit pests after early June. AMF injury was higher in 1994 than in previous years of the pilot program, but was comparable in the second- and first-level blocks (2.6 vs. 2.7%). AMF captures on interior unbaited monitoring traps were similar in first- and second-level blocks (7.4 vs. 8.9).

Injury by CM, LR, and LAW was lower than in 1993, and levels were only slightly higher in second-level than in first-level blocks (Table 4). LR injury decreased from 0.7% in 1993 to 0.1% in 1994. Blocks in which LR had been a problem in the past may have benefited by earlier than usual picking of fruit, particularly of Cortlands. Field observations suggest that significant LR injury in our experimental blocks has usually occurred within the last few weeks before harvest.

Total insecticide use after early June averaged 0.4 dosage equivalents in second-level blocks compared with 1.6 dosage equivalents in first-level blocks (Table 1). Many growers employed greater than usual pesticide spray events in their first-level blocks, due mainly to high AMF numbers and rainy weather.

Foliar Pests and Beneficial Natural Enemies: Full Second-level IPM

Early season management of foliar pests relies on monitoring and chemical intervention if initial pest populations are high. Two dormant oil applications were recommended for control of overwintering ERM eggs. Five red sticky rectangular traps were hung on tree trunks in each block in mid-April to monitor for the emergence of overwintering ABLM adults. Foliar sampling began in late April and focused on ERM and WALH, as well as on the appearance of ABLM eggs. If necessary, pesticide was recommended to control early populations of any of these pests if they existed at problem levels.

Seasonal averages for pest mite populations in 1994 were a bit lower than in 1993. Unlike 1993, most locations

Table 5. Seasonal average populations of pest mites and mite predators in second-level and first-level IPM blocks.*

Type of block	Mite presence (% of leaves) ERM + TSM	Af	YM	Ratio of ERM +TSM to Af
Full second-level	16a	3.6a	4.4a	4:1
First-level	20a	6.3a	2.1a	3:1
Transitional second-level	7a	13.1a	4.1a	1:1
First-level	11a	4.1a	2.1a	3:1

* Means in each couplet in each column followed by a different letter are significantly different at odds of 19:1. ERM = European red mite. TSM = Two-spotted mite; Af = *Amblyseius fallacis*; YM = yellow mite.

did not experience significant mite populations until late summer. Mite populations in second-level blocks were similar to those in first-level blocks (Table 5). A program of double dormant oil applications in the spring was highly effective in suppressing early mite populations, even in cases where overwintering mite egg numbers were high. In contrast to pest mites, phytoseiid mite predators were found at 5 times the levels of 1993 (Table 5). The slow growth of pest mites allowed for good late season biocontrol, as pest mite levels did not peak until predators were present. *Amblyseius fallacis* was at statistically similar levels in first-level and second-level blocks, suggesting that the presence of mite predators was not specific to blocks that received no insecticide after early June. Yellow mites were present in slightly higher numbers in second-level than in first-level blocks, but the difference was not statistically significant (Table 5).

Second-level blocks received slightly less dormant oil and summer oil treatments than first-level blocks, and received no miticides other than oil (Table 1).

Leafhopper populations of all types were abundant in 1994. WALH numbers were slightly higher in second-level than in first-level blocks. One second-level block required one summer insecticide application against WALH. PLH proved more of a problem in 1994 than in 1993, and was found in higher levels in second-level than in first-level blocks. Rose leafhopper was significantly higher in second-level than in first-level blocks. In one second-level block requiring a summer insecticide treatment against RLH, we suggested an application of Omite™ as an alternative to harsher chemicals. The results were acceptable, although not exceptional. While RLH has not been a problem in all second-level blocks, in those blocks surrounded by multiflora rosebushes we have found it to be a consistent concern (Table 6).

Second- and third-generation leafminer populations were higher in 1994 than in 1993 and were similar in first- and second-level blocks (Table 6). Continuing research on ABLM parasitism rates in first-level and second-level blocks again has shown a higher rate of parasitism of second-generation ABLM larvae in second-level blocks (36 vs. 20%). We remain hopeful that parasitism can be proven a successful means of ABLM control in a low-spray program.

Green apple aphid populations were higher in 1994 than in 1993, as were levels of monitored aphid predators (Table 6). We continue to be content with predator control of GAA. Woolly apple aphid populations on watersprouts were at lower levels than in 1993, and were present in similar numbers in both types of blocks (Table 6).

Foliar Pests and Beneficial Natural Enemies: Transitional Second-level IPM

Seasonal averages of mite populations were low in both first- and second-level IPM blocks (Table 5). One second-level block with a high overwintering ERM egg count and only one dormant oil application had very high mite num-

Table 6. Foliar insect pest average population levels in second-level and first-level blocks in 1994.*

Type of block	PLH	WALH	RLH	ABLM	ABLMP	GAA	GAAP	WAA
Full second-level	11a	8a	5a	23a	36a	47a	23a	1a
First-level	4a	5a	<1b	25a	20b	39a	17a	4a
Transitional second-level	13a	7a	3a	10a	36a	32a	12a	0a
First-level	3b	2a	2a	5a	23b	37a	17a	0a

*Means in each couplet in each column followed by a different letter are significantly different at odds of 19:1. PLH = potato leafhopper; WALH = white apple leafhopper; RLH = rose leafhopper; ABLM = apple blotch leafminer; ABLMP = leafminer parasitoids; GAA = green apple aphid; GAAP = green apple aphid predators: cecidomyiids and syrphids; WAA = woolly apple aphid. PLH, WALH, and RLH data are average percentages based on bi-weekly samples of 100 or 200 fruit cluster or terminal leaves or 100 watersprouts. ABLM data are the average number of (second and third generation only) mines per 100 leaves based on bi-weekly samples of 100 or 200 fruit cluster or terminal leaves. GAA, GAAP, and WAA data are percentage watersprouts infested based on bi-weekly samples of 100 watersprouts.

bers initially, and the grower chose to apply a summer oil. Although there was no statistical difference, transitional second-level blocks had greater numbers of phytoseiid predators than any other type of block in 1994, and early problem mite populations were brought under control by predators by late summer (Table 5). Yellow mite populations in first-and second-level blocks were similar (2.1 vs. 4.1%) and also were similar to 1993 levels. Dormant and summer oil applications were slightly lower in second-level than in first-level blocks, as were non-oil miticide applications (Table 1).

PLH levels were significantly greater in second-level than in first-level blocks, a difference from 1993 when levels in both block types were almost identical. Both WALH and RLH populations were higher in second-level than in first-level blocks, although not significantly. In 1994, levels of all three types of leafhoppers were similar in transitional and full second-level blocks (Table 6).

ABLM populations were higher in second-level than in first-level blocks; mine levels were similar to those found in 1993 (Table 6). In general, the transitional second-level blocks fared better than full second-level blocks in terms of mine numbers, but corresponding differences in the two sets of first-level blocks suggest that this may be specific to the orchards chosen and not due to differences in IPM management techniques. Parasitism rates in transitional second-level blocks were the same as those in full second-level blocks (Table 6).

Both GAA and aphid predator levels were greater in first-level than in second-level blocks, although populations in both types of blocks were very similar (Table 6). Predators provided good control of aphid populations in both types of blocks. Woolly apple aphids were absent from both types of blocks (Table 6).

Conclusions

With regard to <u>full second-level IPM</u> practices that involve substitution of cultural, behavioral, and biological control methods for insecticide use after early June, we conclude the following after four years of implementation:

(1) Little buildup of codling moth or leafroller beyond the level existing in nearby first-level blocks;

(2) Noticeable buildup of lesser appleworm from 1991 to 1994;

(3) Consistently slightly greater injury by apple maggot flies in second-level blocks, especially in late-ripening cultivars;

(4) No buildup of pest mites under slightly reduced miticide use but insufficient buildup of predatory mites to permit truly substantial reduction in miticide use (probably as a consequence of negative effects of fungicide on mite predators);

(5) Considerable buildup of parasitoids of leafminers, possibly sufficient to reduce or eliminate need for spray against leafminers;
(6) No buildup of apple or woolly apple aphids beyond that in nearby first-level blocks but greater presence of aphid predators;
(7) Slight buildup of white apple leafhoppers; and
(8) Considerable numbers of potato and rose leafhoppers in second-level blocks after early June, causing foliar damage to watersprouts and terminals (potato) and excrement-spotting of fruit and nuisance to pickers (rose).

With respect to transitional second-level IPM practices that involve no application of insecticide to the block interior after early June but rely on perimeter-row sprays instead of traps for controlling apple maggot flies, we conclude the following after four years of implementation:

(1) No buildup of codling moth and only a slight buildup of leafroller beyond the level existing in nearby first-level blocks;
(2) Slight buildup of lesser appleworm from 1991 to 1994;
(3) Similar level of injury by apple maggot flies in second- and first-level blocks;
(4) No buildup of pest mites under slightly reduced miticide use but not enough buildup of predatory mites to allow much reduction in miticide use;
(5) Little buildup of parasitoids of leafminers;
(6) No buildup of apple aphids, woolly apple aphids or white apple leafhoppers beyond acceptable levels; and
(7) No unacceptable populations of rose leafhoppers during mid- and late-summer.

In sum, transitional second-level IPM offers an advantage over first-level IPM in terms of a substantial reduction in pesticide use during summer months. Transitional second-level IPM does not appear to afford significant biological control of leafminers and may allow buildup of leafrollers and lesser appleworm over time. Full second-level IPM is impractical for most growers at this time as it is labor intensive and is still in need of additional work on control of several pests. In the long run, we believe that if pesticide-treated spheres can be developed and registered as an inexpensive substitute for sticky spheres to control apple maggot, full second-level IPM will be as economical to employ and as effective in controlling pests as first-level IPM while offering additional environmental benefits.

In 1995 we will begin work on specific areas highlighted as shortcomings over our four year second-level IPM pilot project. Research will include intensive study of pesticide-treated spheres, examination of rose leafhopper immigration patterns from multiflora rosebushes into orchard blocks, and a study of the basic biology of the lesser appleworm. Success in these areas is necessary for second-level IPM to become economically feasible in a commercial orchard setting.

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* * * * *

Performance of McIntosh Apple Trees as Affected by Rootstock

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The New England apple industry depends largely on the cultivar McIntosh, which accounts for more than 50% of the planted acreage. Although New England environmental conditions provide an ideal climate for producing very high quality McIntosh, giving the area a niche cultivar, market competition both within New England and in other parts of the country has kept the wholesale returns to McIntosh growers just above the production costs. Growers therefore must pursue all means of reducing input costs, enhancing cost efficiencies, and increasing crop value. Rootstocks, particularly those which result in fully dwarf trees, can affect all of these conditions by reducing some management costs and by enhancing precocity, yield efficiency, and coloring.

A trial was established in April of 1985 to study the relationship among various rootstocks with McIntosh as the scion cultivar. Summerland Red McIntosh was included on M.9/A.2 (Alnarp 2 as the root and M.9 as an interstem), O.3 (Ottawa 3), M.7 EMLA, M.26 EMLA, M.7A, OAR1 (Oregon Apple Rootstock 1), and Mark in a randomized complete block design with seven replications. Spacing was 12 x 20 feet. Trees were not allowed to fruit until 1988, when in their fourth leaf. All trees were pruned minimally; however, because of vigorous spreading, some had to be containment-pruned before the end of the experiment. Trunk cross-sectional area was measured annually, and tree height and canopy spread were measured at the end of the study. Yields per tree were assessed annually. Samples of fruit were taken each year from 1989 through 1994 to assess fruit size, and in 1991, 1993, and 1994, fruit were sampled to assess average red color development.

At the end of ten growing seasons, trees on M.7 EMLA and those on OAR1 were the largest in the planting in terms of trunk cross-sectional area, height, and spread (Table 1). Trees on M.7A were similar in height and spread to those on M.7 EMLA and OAR1, but their mean trunk cross-sectional area was significantly smaller than those on M.7 EMLA. Trees on M.26 EMLA and M.9/A.2 were similar

Table 1. Tree size at the end of the tenth growing season (1994) and projected density of Summerland Red McIntosh trees on seven rootstocks.*

Rootstock	Trunk cross-sectional area (in^2)	Tree height (ft)	Canopy spread (ft)	Projected density (trees/acre)
M.9/A.2	9.1 c	8.8 cd	12.2 abc	237
O.3	6.9 cd	7.5 d	11.0 c	278
M.7 EMLA	18.2 a	11.9 a	13.9 a	132
M.26 EMLA	10.2 c	9.4 bc	11.8 bc	237
M.7A	14.1 b	10.8 ab	12.9 ab	148
OAR1	16.0 ab	11.1 ab	12.4 abc	148
Mark	4.6 d	7.4 d	7.8 d	496

* Within columns, means not followed by the same letter are significantly different at odds of 19:1.

Table 2. Cumulative yield of Summerland Red McIntosh trees on seven rootstocks.*

Rootstock	Cumulative yield (1988-94) Per tree (bu)	Per trunk cross-sectional area (efficiency) (bu/in^2)	Per planted area (projected) (bu/acre)
M.9/A.2	12.4 b	1.42 b	2930 ab
O.3	12.6 b	1.84 a	3500 a
M.7 EMLA	20.6 a	1.14 cd	2720 ab
M.26 EMLA	13.4 b	1.35 bc	3170 ab
M.7A	14.6 b	1.04 d	2170 b
OAR1	6.9 c	0.43 e	1030 c
Mark	7.5 c	1.71 a	3740 a

* Within columns, means not followed by the same letter are significantly different at odds of 19:1.

in size. Trees on O.3 were similar in trunk cross-sectional area and spread to those on M.26 EMLA and those on M.9/A.2 but were significantly shorter than those on M.26 EMLA. The smallest trees in the planting were on Mark. Projected planting densities presented in Table 1 were based partially on tree spread and on visual observation of the canopy developement and vigor and represent a "best guess" of the optimal density for these trees at the site on which they where grown.

Trees on M.7 EMLA yielded the most per tree cumu-

Table 3. Average box count of fruit from Summerland Red McIntosh trees on seven rootstocks. All means were adjusted for the effects of crop load.*

Rootstock	1989	1990	1991	1992	1993	1994
M.9/A.2	98 a	--	123 a	116 a	110 ab	122 ab
O.3	102 ab	125 a	127 a	116 a	111 ab	116 a
M.7 EMLA	105 b	139 b	122 a	115 a	106 a	119 ab
M.26 EMLA	104 ab	125 a	120 a	119 a	106 a	121 ab
M.7A	104 ab	141 b	123 a	117 a	109 ab	118 ab
OAR1	--	157 c	165 b	130 b	123 c	127 b
Mark	122 c	128 ab	125 a	132 b	116 bc	126 ab

* Within columns, means not followed by the same letter are significantly different at odds of 19:1.

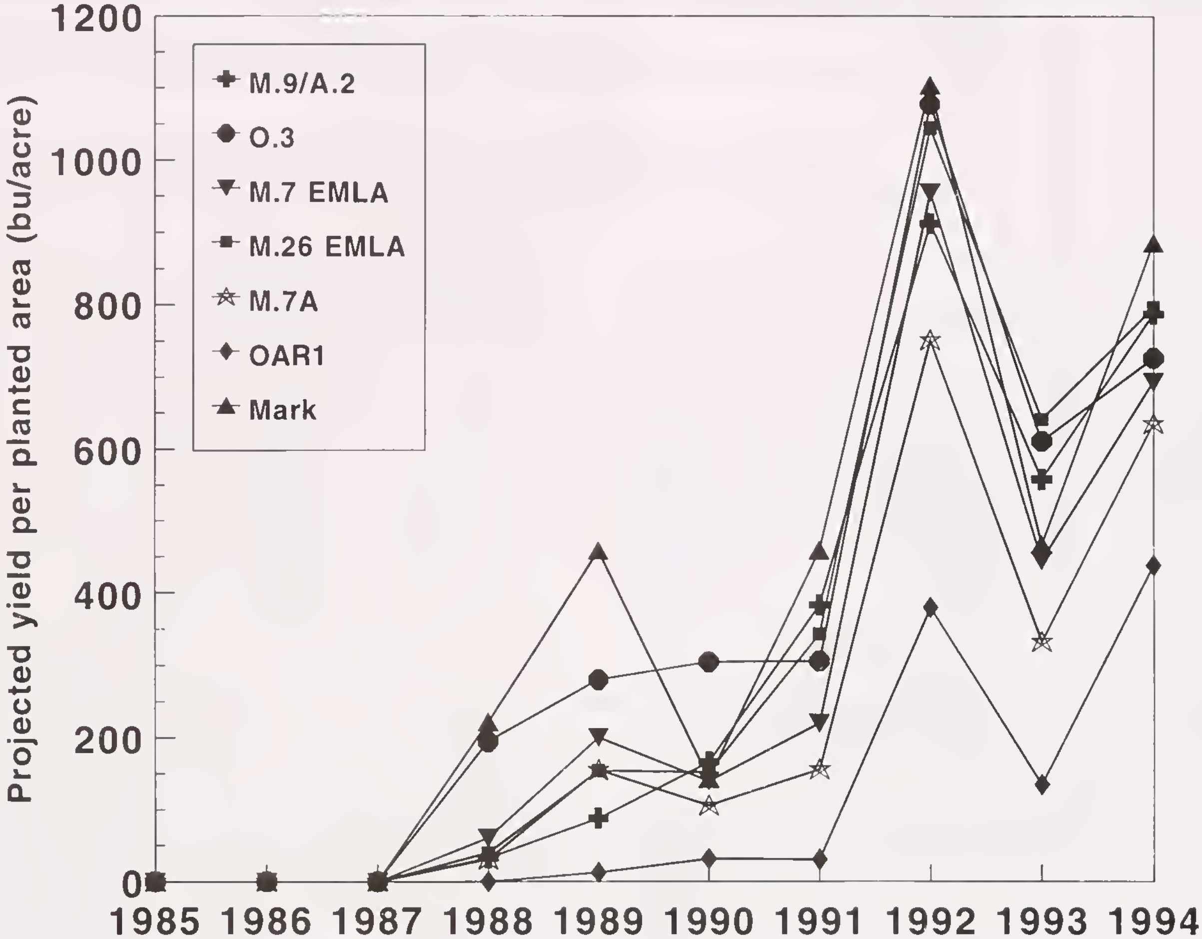

Figure 1. Projected annual yields per acre of Summerland Red McIntosh trees on various rootstocks. Projected yields were based on annual per-tree yields and projected tree densities (Table 1).

latively (Table 2) and also in most years. Trees on M.9/A.2, O.3, M.26 EMLA, and M.7A yielded similarly, and trees on OAR1 and Mark yielded the least per tree.

To relate yield to tree size, it commonly is expressed on the basis of trunk cross-sectional area and referred to as yield efficiency. Efficiency was greatest for trees on O.3 and Mark (Table 2). Trees on M.9/A.2 and M.26 EMLA were the next most efficient, followed by trees on M.7 EMLA and M.7A. The least efficient trees were on OAR1.

The best estimate of relative yield capabilities may come from a projection of the yield per acre (Table 2, Figure 1). This projection is partially subjective since it is based on a projection of tree density per acre, but it gives some basis for comparison that is rooted in a "real-world" measurement. By this measurement, the most productive trees cumulatively were on Mark, O.3, M.26 EMLA, M.9/A.2, and M.7 EMLA. The least productive were on OAR1.

The effects of rootstock on fruit size varied from year to year (Table 3); however, O.3, M.26 EMLA, and M.9/A.2 consistently resulted in fruit in the largest category. OAR1, on the other hand, consistently resulted in fruit in the smallest category. M.7 EMLA, M.7A, and Mark were not consistent in their effect on fruit size.

The effects of rootstock on fruit color also varied from year to year (Table 4); however, Mark resulted consistently in percent red color development in the highest category. M.7A and M.7 EMLA resulted consistently in red color development in the lowest category. Color development of fruit from trees on OAR1, M.9/A.2, M.26 EMLA, or O.3 was inconsistent or intermediate.

Table 4. Surface red color (%) of fruit from Summerland Red McIntosh trees on seven rootstocks.*

Rootstock	1991		1993		1994	
M.9/A.2	81	b	68	b	76	ab
O.3	82	ab	66	b	70	bc
M.7 EMLA	79	b	58	c	66	c
M.26 EMLA	82	ab	68	b	75	ab
M.7A	83	ab	63	bc	69	bc
OAR1	89	a	68	b	81	a
Mark	83	ab	79	a	79	a

* Within columns, means not followed by the same letter are significantly different at odds of 19:1.

Conclusions

The ideal rootstock for any particular cultivar is the one that results in the best return to the grower. Generally, the best return is the result of high yields of fruit which are of large size and good color.

In this trial, trees on Mark and those on O.3 were high yielding, in terms of either yield efficiency or projected yield per acre. They were not significantly greater in terms of cumulative yield per acre, however, than trees on M.26 EMLA, M.9/A.2, or M.7 EMLA. To determine which of these rootstocks performed the best, other factors, such as size and color, must be considered. In this study, O.3, M.26 EMLA, and M.9/A.2 resulted in fruit size in the largest category each year, and Mark tended to result in fruit in the smallest category, although not consistently. Color, on the other hand, was consistently greater for fruit from trees on Mark. M.7 EMLA and M.7A resulted in the poorest coloring.

Although the results may not be absolute, O.3 appears to have performed the best. It met the criterion of producing high yields of large and relatively well colored fruit. M.26 EMLA and M.9/A.2, however, also performed well. Mark's effects on fruit size were a significant detriment, as were M.7 EMLA's and M.7A's effects on red color development.

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Growing Gala Apples in Massachusetts

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Gala has been one of the most heavily planted apple cultivars in the past few year. Now that some trees are in full production, it is apparent that growth and management, harvesting, and storage of Gala are different from other cultivars that we are familiar with growing. This paper summarizes some of the modifications and changes that will allow us to grow large, premium quality Gala apples.

Strains

Gala originated in New Zealand and the standard strain is known as Kidd's D-8. The standard Gala is a very attractive apple because it develops a beautiful orange-red color when ripe. There are several other strains of Gala that have been selected primarily for increased red color. All red coloring strains develop more red color, and they generally are more attractive than Kidd's D-8. All strains of Gala appear to be somewhat comparable, except for the slightly redder color and earlier ripening of Regal (Fulford) Gala. Flavor and quality of red coloring strains appear to be comparable to those of Kidd's D-8. You would not go wrong with selecting any of the red coloring strains.

Growth Habit

Gala is a vigorous tree and it should be grown vigorously. Trees should be staked since they sometimes have a structural weakness at the graft union, particularly when propagated on M.26 rootstock. Trees have willowy branches that are brittle and bend very easily. We do not recommend spreading branches of Gala trees at any age. If limb spreaders are put in, limbs are frequently broken.

Pruning

Proper pruning is more important on Gala than on any other cultivar that we grow. On most cultivars, aggressive pruning reduces flowering and fruit set of apples. This response is less prominent with Gala. It flowers heavily even on upright wood. Many of these flowers set, so cropping is not reduced by pruning. Gala has brittle wood. If left unpruned or lightly pruned, the branches act like an umbrella and layer themselves one on top of another. Fruit do not size, color, or mature properly when this happens. Spurs become weakened because of a lack of sun and this predisposes them to produce small fruit in the future.

Shortening and stiffening branches is an important procedure to prevent drooping and to reduce breakage. More severe pruning than with other cultivars appears to be appropriate. This practice does several things. It removes some of the flowers from the tree. It stiffens branches and allows much better light penetration. It stimulates vegetative growth, and vigorous shoot growth is required for good fruit size. It also renews fruiting wood. All hanging branches should be removed. Summer pruning, done at the traditional time in August, does not appear to be a useful activity on Gala. Color, size, and packout are notimproved substantially when pruning is delayed until late in the growing season.

Flowering

Gala is a very precocious tree, thus it blooms and sets fruit very early in the life of the tree. It produces flowers on one-year-old wood and on spurs. The type of bloom that we want for most apples is spur bloom since that produces the largest fruit. Lateral bloom in most circumstances is undesirable because it produces small inferior quality apples that often have poor finish. Because of their location at the ends of branches they pull branches down too much. Pruning and thinning strategies should include removing as many lateral flowers and fruit as possible.

Chemical Thinning

A key to good fruit size, high fruit quality and adequate return bloom is good fruit thinning. We have worked and continue to work on chemical thinning strategies. Carbaryl is useful but frequently it is not potent enough for Gala. Some combination of carbaryl with NAA seems to be most appropriate. Aggressive thinning is required in some years, whereas in others it is not. Since we have been unable to predict the situation where aggressive thinning is appropriate, a more moderate approach to chemical thinning is in order to prevent complete defruiting of trees. Specifically, 3 ppm NAA plus 1 lb Sevin 50WP is a good level to try, being aware that some had thinning may be required. Accel™ does not appear to be very effective for either removing fruit or increasing fruit size with Gala.

Hand Thinning

As stated above, Gala may require some hand thinning. Hand thinning is an opportunity to remove fruit on one-year-old wood and to space fruit on spurs for maxi-

mum light interception. It is our experience that hand thinning pays for itself in higher fruit quality, larger fruit size, and better packout.

Fruit Size Strategies

Gala naturally is a medium to small sized apple. Special efforts are required to produce large Gala apples. Any cultural activity that increases spur leaf area will increase fruit size. Work in New Zealand suggests that increasing the number of fruit borne on short shoots is important. Work in Massachusetts suggests that fruit size on two- and three-year-old spurs is comparable to fruit size on short shoots as long as leaf area is comparable. Good chemical and hand thinning is critical. Maintaining proper vigor of the tree is important. Attention to thinning, ground cover management, all aspects of pruning, fertilization, and pest management as it influences leaf quality are all required.

Harvest

Gala has the reputation for requiring several harvests. To a certain extent this is true. Proper pruning to position fruit in the appropriate light and good chemical thinning followedby hand thinning will reduce the number of harvests. Using these techniques we have been able to reduce the number of harvests required for Gala to just two.

Careful attention to the proper time of harvest is important. Gala can mature through the proper time of harvest very rapidly. Blocks should be monitored frequently as harvest approaches. Red color is a very poor indicator of maturity. Starch charts have a limited use. Careful monitoring of ground color is undoubtedly the best method. We developed a ground color chart several years ago using Pantone color charts. It appears to be a very reliable predictor of the proper time of harvest. On this chart half way between green and yellow, nearly white, appears to be the proper stage of maturity to harvest Gala.

Storage

Gala is not a long storing apple. There is a noticeable loss of condition in storage after two months. It also loses much of the aromatic character after extended storage. Gala can be kept in CA storage but the atmospheres used can kill the enzyme responsible for giving Gala the characteristic aromatic flavor and fruitiness. It is not the same apple out of CA storage.

One of the parents of Gala is Golden Delicious. Like Golden Delicious, Gala shrivels in storage. We have seen unacceptable shriveling in regular storage after one month. The length of time before shriveling starts to occur depends upon the year, and presumably wax components in and on the skin. Gala should be stored in plastic bags, similar to those used for Golden Delicious.

Hardiness

The 1994 winter was a test winter. In general Gala proved to be hardier than anticipated. We would characterize it as neither tender nor very hardy. However, Gala is incredibly sensitive to cold temperature in the spring. If leaves are damaged by frost, fruit set will be reduced. Gala is the most sensitive cultivar I have seen to cold temperature, once buds start to swell and leaf tissue expands. Plant Gala on sites that are not prone to spring frosts.

Pruning Gala Apple Trees to Increase Fruit Size and Quality

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Gala apples have been grown successfully in Massachusetts since 1978. New England appears to have a favorable climate to produce attractive, high quality Gala; however, they can be grown profitably only when fruit size is large. Gala is an apple that normally has medium to small fruit, so special tree management is necessary to produce large fruit that are well colored.

Pomologists for many years have recognized that dormant pruning is a way to increase fruit size of apples. However, if trees are pruned heavily during the dormant season, vegetative growth usually is stimulated, which reduces fruit set, lowers fruit quality, and reduces return bloom. Part of the problem is the shade caused by the new shoots, but summer pruning in July or August will help reduce this effect.

In addition producing small fruit, Gala trees are difficult to thin, they bloom and frequently set a heavy crop on upright branches and on one-year-old wood, and they have wood that is very flexible and willowy. We noted during the past few years, as we were developing a strategy to grow large Gala, that heavily pruned trees bore the largest and highest quality fruit. Fruit on trees that were lightly or moderately pruned were smaller and had poorer color. On these less-pruned trees, a larger number of fruit were borne on one-year-old wood and weak spurs, and therefore were naturally smaller than ideal. Additionally, limbs drooped and shaded each other, reducing fruit coloring.

An experiment was initiated to determine if heavy, yet appropriate, dormant and summer pruning could be used as tools to increase the fruit size and color of Gala apples.

Thirty two trees in a planting of eight-year-old Royal Gala/M.26 were selected and grouped into eight blocks (replications) of four trees each at the Horticultural Research Center in Belchertown, Mass. In March, two trees in each block received moderately heavy pruning while the remaining two were lightly pruned. On heavily pruned trees, branches were thinned out and limbs were stiffened by cutting into two- or three-year-old wood. All hanging branches and some one-year-old wood were removed. Light pruning consisted of completely removing crowded branches and thinning the tops of trees. One heavily and one lightly pruned tree in each block were summer pruned in August. Summer pruning consisted of removing upright shoots to improve light penetration and eliminating some hanging branches. The severity of summer pruning was considered moderate. Trees were thinned

Table 1. Effects of dormant pruning severity on bloom, fruit set, fruit size, and fruit color of Royal Gala apples in 1994.*

Measurement	Heavy pruning	Light pruning
Bloom density (clusters/cm^2 limb cross-sectional area)		
Spurs	6.2 b	11.1 a
One-year-old wood	2.5 b	6.8 a
Total	8.7 b	17.9 a
Fruit set (fruit/cm^2 limb cross-sectional area)		
Spurs	4.3 b	6.1 a
One-year-old wood	0.5 b	1.5 a
Total	4.9 b	7.6 a
Fruit weight (g)	158 a	135 b
Red color (%)	78 a	73 a

* Within rows, means not followed by the same letter are significantly different at odds of 19:1.

chemically at petal fall with carbaryl at 1 lb/100 gal. and again at the 10-mm stage of fruit development with a combination of 5 ppm NAA and 1 lb/100 gal carbaryl. No hand thinning was done.

At the pink stage of flower development, two limbs, 1.5 to 2.5 inches in diameter were selected and tagged. Spur and one-year-old flowers were counted and recorded separately. At the completion of June drop in July, all fruit originating from spurs or one-year-old wood were counted.

At the normal harvest time, 30 fruit were harvested from each tree: 15 from the upper portion of the tree and 15 on the periphery of the lower tier of branches. Fruit were weighed and the percent of red color on the surface of each apple was estimated to the nearest 10%.

Bloom on lightly pruned trees was heavy and over one-third of this bloom was located on one-year-old wood (Table 1). Dormant-pruned trees had less spur and one-year-old bloom. Fruit set on lightly pruned trees was excessive even though the trees received two chemicalthinning treatments that were deemed appropriate for the situation. Fruit set on heavily pruned trees was nearly ideal (30% less than for lightly pruned trees), and the amount of fruit on one-year-old wood was reduced to one third of the number on lightly pruned trees. Summer pruning of either lightly pruned or heavily pruned trees had no measured effect (data not shown).

Weight of fruit on heavily pruned trees averaged about 158 grams (2.81 inches diameter) while those on lightly pruned trees averaged 136 grams (2.64 inches diameter) (Table 1). No pruning treatment affected percent red color (Table 1), but the color on all fruit was acceptable due to good coloring conditions. Summer pruning did not affect fruit quality (data not shown).

We have established that heavy pruning of Gala achieved several important goals. First, dormant pruning can be used in conjunction with chemical thinning to help reduce crop load to an appropriate level. Furthermore, heavy pruning eliminated much of the fruit set on one-year-old wood, fruit which are small and of inferior quality. Additionally, reduction of this fruit, which is located near the ends of branches, reduces the drooping of branches and shading of fruit below.

Part of the lack of effect of pruning on fruit color may be attributed to sampling technique, which was a random selection of fruit from the top and periphery of the tree. If some fruit from the shaded portion of the tree had been sampled, light pruning probably would have reduced red color primarily by allowing branches to shade each other. Although no data were collected, this result was observed during harvest.

Summer pruning did not appear to be very useful for Gala, since shading is the result of drooping branches, not excessive upright growth. Summer pruning which shortens branches and eliminates some of the drooping will remove some fruit. This type of pruning must be done while fruit are still small so as to reduce bruising caused by fruit falling through the canopy.

The moderately heavy pruning used in this investigation did not stimulate excessive vegetative growth, even in the tops of trees. Return bloom will be determined this spring. Based upon observation of appropriate fruit set and moderate vegetative growth, however, we speculate that heavily pruned trees will have adequate bloom. Heavy set on lightly pruned trees may result in reduced flower bud formation.

We conclude that moderately heavy pruning of Gala is a useful management tool to increase fruit size. Further work will be required to determine possible long-term effects of heavy dormant pruning. Early summer pruning should also be evaluated.

Effects of Pesticides on Pest Ecology in Blocks of Scab-resistant Apple Cultivars

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We have described previously our attempts to eliminate orchard applications of insecticide and miticide after early June and to limit the use of fungicide over the entire growing season, utilizing second-level IPM and scab-resistant cultivars [*Fruit Notes* 59(1): 8-12, 1994]. This approach may allow the increase of natural enemies of arthropod pests to provide significant biological control. It also may slow rates at which pests develop resistance to pesticides and minimize potential risks from pesticide residues on fruit at harvest.

The study detailed here differs from those of second-level IPM (see earlier article in this issue) in that scab-resistant apple cultivars (SRCs) are used, rather than commercial cultivars. Presently the commercial acceptance of SRCs does not make them suitable for wide-scale planting; however, small plantings may serve very limited markets. In addition, these plantings provide sites which allow us to study the effects particularly fungicides on the orchard ecology, since fungicides directed at scab can be eliminated from the pest management program without affecting tree and fruit development directly. We are particularly interested in the effects that fungicides may have on mites and insects.

In our earlier article we described our reasons for suspecting that fungicides may increase pest mite populations. We know that one fungicide, benomyl, can sterilize predaceous phytoseiid mites. We also know that there are naturally-occurring fungi which can infect and kill insects and mites, and that these fungi may be inhibited by fungicides. While the mechanism behind fungicide effects on mites is only crudely understood, work in Vermont confirms that eliminating fungicides from an orchard can stimulate mite biocontrol.

Unfortunately, eliminating fungicides in SRC blocks comes with a few problems. Last year, elimination of fungicides combined with second-level arthropod management in blocks of SRCs produced fruit with acceptable levels of arthropod damage, but not of flyspeck and sooty blotch, which affected 7% and 4% of the fruit, respectively. In blocks under standard fungicide management, the damage levels were only 0.1% and 0.4%, respectively. In addition, work in New York has shown that elimination of fungi-

Table 1. Pesticide dosage equivalents (DE) applied to sections of four blocks of scab-resistant apple cultivars.

Fungicide treatment	Arthropod treatment	Fungicide DE: Before mid-June	Fungicide DE: After mid-June	Insecticide DE: Before mid-June	Insecticide DE: After mid-June	Miticides	Total DE
Fungicide	First-level	3.0	1.2	2.9	2.4	0.5	10.0
Fungicide	Second-level	3.0	1.2	2.9	0.6	0.3	8.0
None	First-level	0.0	0.0	2.9	2.4	0.5	5.8
None	Second-level	0.0	0.0	2.9	0.6	0.3	3.8

cides may lead to a sequence of events over two seasons, beginning with premature defoliation in the fall and progressing to decreased fruit bud viability, decreased set and decreased production. It thus appears that fungicides have positive effects on fruit production which go beyond the direct benefits of controlling common diseases.

Pesticide Treatment in Scab-resistant Blocks

In order to study the effects of pesticides on the ecology of orchards, a block of SRCs in each of four commercial orchards was selected and each was partitioned into four sections. Treatments were divided randomly among the four sections: 1) fungicide, insecticide and miticide applications made using first-level IPM methods; 2) fungicide applications made using first-level IPM, and arthropod management done using second-level IPM; 3) no fungicides, and arthropod management done using first-level IPM; 4) no fungicides, and arthropod management done usingsecond-level IPM. The second-level IPM techniques used were described earlier in this issue, except that pesticide-treated spheres were used to manage apple maggots.

Results and Discussion

Fungicide treatment and arthropod treatment each had a significant effect on the total amount of pesticide used for the season (p 0.05). Table 1 shows that on average 4.2 dosage equivalents (DEs) of fungicide were applied in fungicide-treated sections. The rest of each block received no fungicides. The first-level IPM sections of blocks received 5.3 and 0.5 DEs of insecticides and miticides, respectively, while the sections under second-level IPM received 3.5 and 0.3 DEs, respectively.

As would be expected, omitting fungicides had a significant effect on sooty blotch and flyspeck (Table 1). The summer disease incidence was much higher in the sections where no fungicide was used. The arthropod treatment, either first-level or second-level IPM, did not have a significant effect on summer disease, nor was there any interaction between the fungicide treatments and arthropod treatments (data not shown).

There was also a significant negative correlation between the number of DEs of fungicide applied over the season and the incidence of sooty blotch (r=-0.83) and flyspeck (r=-0.87), which means that the more fungicide that was applied over the entire growing season, the lower was the summer disease incidence. The DEs applied over the entire season had higher correlation values with summer disease than did the DEs after June 15, indicating that the entire season's fungicide program has more effect on disease than the summer fungicide applications alone.

The application of fungicides also was significantly related to European red mite populations. DEs of fungicides applied after June 15 were positively correlated with European red mite populations (r=0.62), indicating that more applications of fungicide in the summer were related to higher red mite populations in the blocks, as illustrated in Figure 1. The DEs applied for the season were not as highly correlated (r=0.27). The statistical strength of these relationships indicates that other factors are affecting the red mite populations, as would be expected, but fungicides do appear to play a role in growth of red mite populations. The populations of the other major pest mite in orchards, the two-spotted mite, were very low, approaching or at zero in most orchards.

The major predator mite observed in these orchards was the yellow mite. Fungicide use correlated with a significantly lower yellow mite populations. While some orchards had few if any yellow mites, in those orchards with these predators, populations were lower in fungicide-treated sections.

Neither arthropod treatments nor fungicide treatments had significant effects on several other foliar pests and ben-

Table 2. Percent of fruit with sooty blotch and flyspeck damage, and percent of leaves with mites and mite predators, from sections of four blocks of scab-resistant apple cultivars.*

Treatment	Sooty blotch	Fly speck	ERM	TSM	AF	YM
Fungicide	0.3 a	0.7 a	29.8 a	0.1 a	4.2 a	3.9 a
No fungicide	11.7 b	13.4 b	21.5 b	0.0 a	3.9 a	10.0 b

* Within columns, means not followed by the same letter are significantly different at odds of 19·1. ERM=European red mite; TSM=Two-spotted spider mite; AF=*Amblyseius fallacis*; YM=yellow mite.

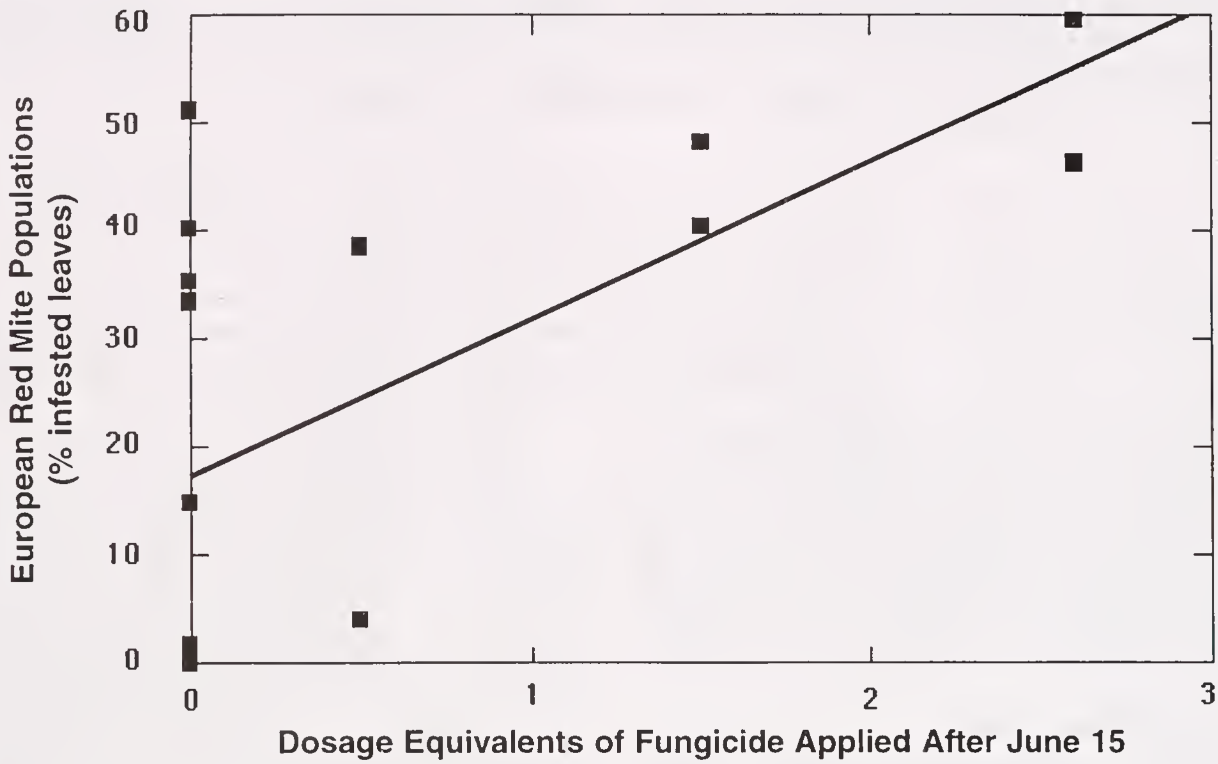

Figure 1. European red mite populations as a function of dosage equivalents of fungicide applied during the summer in four blocks of scab-resistant apple cultivars.

eficial insects: white apple leafhopper; rose leafhopper; potato leafhopper; green apple aphid; leafminer; syrphid fly; or cecidomiid fly. Fruit damage by insects was not evaluated by fungicide treatment, but insect damage was evaluated by arthropod treatment. Of the fruit pests evaluated (codling moth, European apple sawfly, plum curculio, tarnished plant bug, leafroller, green fruitworm, and lesser apple worm) all damage was the same regardless of arthropod treatment. Fruit damage from apple maggot fly was significantly higher in the second-level blocks using spheres than in the sprayed blocks, with damage levels at 6.1% and 3.1%, respectively.

In one SRC block, we also examined the amount of defoliation under the different pest management strategies. The number of leaves on a terminal at the end of October was counted. There were significantly fewer leaves on trees which did not receive fungicides. There were significantly more leaves on trees which were treated with a full insecticide and fungicide program, while

Table 3. Amount of defoliation on Liberty apple in Ashfield, Oct. 31, 1994.*

Fungicide treatment	Arthropod treatment	Number of leaves per terminal
Fungicide	Standard	8.7 a
Fungicide	Second level	6.7 b
No Fungicide	Standard	3.3 c
No Fungicide	Second level	2.4 c

* Within columns, means not followed by the same letter are significantly different at odds of 19:1.

treatments which received fungicides and second-level insecticide treatments had more leaves than the non-fungicide treatments, but fewer than the full insecticide treatments.

Conclusions

While it appears that eliminating fungicides may improve mite biocontrol, there appear to be no beneficial effects of such elimination in terms of other pests and it is abundantly clear that the cost of eliminating fungicides is not small. Summer disease incidence increases greatly without fungicide use. Furthermore, defoliation increases, and may decrease subsequent fruit set. One solution to the mite biocontrol vs. fungicide dilemma may be the reduced use of fungicides, which has not been tried yet. Limited fungicide applications, as opposed to no fungicide use, may also benefit trees in terms of premature defoliation.

It is also a concern that the pesticide-treated spheres did not control maggot as well as the standard insecticide treatments. Wet weather made it difficult to keep feeding stimulant on the spheres. This problem will need to be remedied if the approach is to be effective.

Acknowledgments

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Tax Pointers for Farmers and Landowners in 1994

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Tax advice given below is intended as general advice and is believed to be correct. It does not substitute for a detailed review of the circumstances of an individual taxpayer by a professional tax practitioner. For more details, you and your tax adviser may wish to consult the sources referenced in the square brackets [thus] (see footnote).

No new federal tax legislation was passed last year; however, a number of provisions of the 1993 Revenue Reconciliation Act became effective on January 1, 1994.

Health Insurance

If you were a **self-employed** person in 1993 (or an S-corporation shareholder) you were able to deduct (on line 26 of your 1993 Form 1040) 25% of your **health insurance premium**. The bad news is that **this provision expired on December 31, 1993 and is therefore not available** for 1994. The good news is that Congress is expected to extend the provision and will probably make it retroactive. If so, you will need to file for a refund on Form 1040X. [I.R.C. §162(l)]

100% Medical Writeoff?

A number of tax advisers have been advertising a totally legal way for a self-employed person to deduct 100% of health insurance premiums. Basically, the taxpayer treats his or her spouse as an employee entitled to health insurance and purchases insurance for the employee that includes health benefits for the spouse. There may be substantial tax benefits, but the approach is not costless. The spouse must be treated as a common law employee. As employer, the sole proprietor now has to engage in all the paperwork and actions associated with income tax withholding, deductions for social security, etc. For a farmer who already employs non-relatives, the additional paperwork would be minimal. However, the health insurance may need to be offered to all or most of the employees. The advice of a professional tax planner is essential for anyone contemplating this approach. [I.R.C. §105]

Charitable Donations

Effective January 1, 1994, **single charitable donations of $250** or more may be deducted (on Schedule A) **only if** the charity provides you with **written substantiation**, including a good-faith estimate of the value of any good or service that you provided. If you donated money, **you may not rely solely on a cancelled check as substantiation.** Separate payments to the same charity (e.g. by withholding from wages) will be treated as separate contributions, even if they aggregate to more than $250. [IRS temporary and proposed regulations T.D. 8544; IA-74-93 (published May 27, 1994) relating to I.R.C. §170(f)(8).]

As an example of the donation of the development rights on a tract of land, a taxpayer made a donation that was a qualified **conservation contribution** and claimed a deduction on his return of the value of the development rights. The IRS disallowed the entire deduction. The TaxCourt allowed the deduction and specified that the deductible amount was to be determined by comparing the before value and the after value of the property. The before value was the purchase price. The after value was the net income (the land was used as a duck hunting club) capitalized at 4% to get the fair value. [Schwab vs Commissioner, 67 TCM, T.C. Memo 1994-232, May 25, 1994]

Depreciation Allowed or Allowable

A recent Tax Court case confirmed what most taxpayers know: according to §1016(a) of the Internal Revenue Code, the basis of property, when computing gain must be reduced by the depreciation allowed **or allowable**. In the court case, taxpayers owned rental property that was foreclosed. They reduced their basis by the amount of depreciation taken ($43,000) and claimed a loss of $20,500 on the sale. The IRS determined that the allowable depreciation was $95,123 resulting in a taxable gain of $31,623. [Perry M. and Janice S. Brock vs Commissioner, 67 TCM, T.C. Memo 1994-177, April 20, 1994]

Involuntary Sale of Land

The owner of a farm who was **forced to sell** was allowed to use the entire proceeds to purchase **and improve** new property. He thus **deferred the entire capital gain** from the sale. As an example, the owner of an active farm sold it to a city rather than have the land taken by eminent domain. He bought other land and erected buildings on the new property, similar to those that existed on the old farm. With involuntary conversion [I.R.C. §1033], gain can

be deferred on the sale of land when the proceeds are reinvested in like-kind property even though the taxpayer, to fully reinvest the proceeds, will make substantial improvements on the replacement property. (Gain can normally be deferred until the end of the second tax year after the property was disposed of or requisitioned.) [LTR 9421002]

Deductibility of Points

The **immediate deductibility** of points (prepaid interest) **now includes points paid by a seller**. The same conditions for immediate deductibility must be met (as outlined below) and the buyer must deduct the amount of seller-paid points from the purchase price in computing the basis of the residence.

The IRS will treat points paid by a **cash basis taxpayer** as a deductible expense in the taxable year that they are incurred, provided they are: (1) designated on the Uniform Settlement Statement (Form HUD-1) as payable in connection with a loan, (2) computed as a percentage of the amount borrowed, (3) charged under established business practice, (4) paid for the acquisition of a principal residence with the loan secured by that residence, and (5) paid directly to the taxpayer from funds that have not been borrowed for that purpose.

Cost of points **may not** be deducted immediately and must be amortized over the life of the loan if: (1) the loan is for improvement of the principal residence, not purchase, (2) the residence is not the principal residence, or (3) the loan is a refinancing, home equity, or line of credit.

The change is retroactive. If you have been amortizing points paid during tax years beginning after December 31, 1990, and before January 1, 1994, and you qualify for immediatedeductibility, as noted above, you may file an amended tax return on Form 1040X for the appropriate year. Taxpayers filing amended returns should write "Seller-paid Points" in the top right margin of the amended return and should attach a copy of Form HUD-1 (or other settlement statement) showing the amount of points paid by the seller in connection with the transaction on Form 1098, or on line 10 if the points were not reported on Form 1098. [Rev. Proc. 94-27]

Selling of Processed Farm Products

Farmers who **process their produce beyond that normally carried out on a farm may have to file both Schedule F and Schedule C.** The term "farming business" DOES NOT include the processing of commodities or products beyond those activities which are normally incident to the growing, raising, or harvesting of such products. However, the term "farming business" DOES include processing activities which are normally a part of the growing, raising or harvesting of agricultural products. For example, assume a taxpayer is a fruit and vegetable grower. When the fruits and vegetables are ready to be harvested, the taxpayer picks, washes, inspects, and packages the fruits and vegetables for sale. Such activities are normally a part of the raising of these crops by farmers. The taxpayer will be considered to be in the business of farming with respect to the growing of fruits and vegetables, and the processing activities incident to their harvest. [Treas. Reg. 1.263A-4T(4)]. **Maple syrup production** is also a farming activity. Activities that are part of the farming business appear on Schedule F. The rest appear on Schedule C.

Example: Johnny and Jane Seed have an apple orchard and they sell some apples to a wholesaler. They also sell some apples through their roadside stand and make apple cider that they sell to a grocery store. The receipts from the wholesaler and from the roadside stand are reported on Schedule F. The sale of cider is on Schedule C.

Payment in kind to Agricultural Workers

Payment of non-cash wages to an employee may be a legitimate way to share the returns from risk-taking or it may be intended simply to lower the wages subject to FICA and hence reduce the FICA taxes paid by both employer and employee. The IRS will **disallow** the transaction if its purpose is simply to avoid the payment of FICA taxes. Note: it may not always be to the employee's advantage to reduce FICA taxes since this can reduce social security benefits. Wages not subject to FICA also are not subject to income tax withholding; however they are still subject to income tax (and must be reported on the employee's W-2 form but not in box 3).

In two recent situations the IRS held that the circumstances indicated that wages paid to farm employees in the form of grain rather than cash had no business purpose other than to avoid payment of FICA. The IRS treated the payments as though they were cash and were therefore subject to FICA. What makes a bona fide non-cash transfer to an employee? Factors to consider include:

(1) whether there is documentation of the transfer,
(2) whether the in-kind payment was intended to be a substitute for cash,
(3) whether the employee negotiates the subsequent sale independent of the employer,
(4) whether the risk of gain or loss (both of price and physical damage) is shifted to the employee,
(5) the length of time between employee's receipt of the commodity and its subsequent sale,
(6) whether the employee bears the ownership costs (storage, insurance, etc.).

For a bona fide transaction, the employee should bear the ownership costs and **must** exert "dominion and control" over the commodity. The IRS is planning to issue guidelines for meeting the requirements of the law that are likely to be quite stringent. Affected taxpayers should note that **the conditions listed above are subject to revision, possibly substantially**. [I.R.C. §3121(a)(8)(A) as affected by LTR 9428003 and LTR 9403001]

Rental of Jointly Owned Farmland

It may be possible for a farmer to pay rent to a co-owner spouse on land used for farming. The purpose is to reduce the income subject to self-employment tax. The farm income is reduced by the amount of the rent payment and the spouse reports the rental income on Schedule E where it does not attract self-employment tax. Note: it may not always be advantageous to reduce self-employment taxes since social security benefits may also be reduced.

The view of the IRS is that a deduction for rental expense is allowable only if the arrangement between spouses is **a bona fide landlord-tenant relationship**. This would require, among other acts, that the spouse owner avoid material participation in the farm business (for definition, see later section), that he or she issue Form 1099 for all rent payments, that a formal written lease be executed, that rents be at market rate and be paid regularly, and thus the receipts be kept in a separate account. If the landlord spouse is the sole owner, mortgage interest and property taxes should be paid from a separate account. The spouse operator can be a co-owner (see the case of Cox vs Commissioner described below) but a better situation would be presented if the operator was strictly a non-owner tenant. **Transactions between family members are likely to attract close scrutiny by the IRS. Where the spouses are co-owners, the IRS is most likely to disallow the rental deduction**, despite the Tax Court ruling in the Cox case.

In the Cox case, the husband, an attorney, rented space in a building owned by himself and his wife as tenants by the entirety. They reported rent of $18,000 on Schedule E and mortgage interest deductions on the same form. The husband reported deductible rental expenses on his Schedule C. Because **tenancy by the entirety is a separate legal entity** (the marital community) the Tax Court allowed the wife to report one half of the $18,000 as income and the attorney to deduct $9,000 rental expense. He cannot deduct the other one-half because of his equity interest in it (I.R.C. §162(a) allows a deduction for all ordinary and necessary expenses incurred to carry out a trade or business including "(3) rentals or other payments required to be made as a condition to the continued use or possession, for purposes of the trade or business, of property to which the taxpayer **has not taken or is not taking title or in which he has no equity**"). [Sherman and Maxine M. Cox vs Commissioner, 66 TCM, July 22, 1993]

Form 4835 or Schedule F?

Landowners who pay a share of the expenses of the farm or who receive a part of the crop as rental payment but **who do not materially participate** in the business of farming must file Form 4835. A landowner in the business of farming files Schedule F and is subject to self-employment tax. A taxpayer filing Form 4835 who received conservation reserve payments would generally not pay self-employment tax on them. The same taxpayer would generally be subject to passive activity rules that limit the deduction of losses. [I.R.C. §1402(a)(1)]

Confused about Material Participation Rules?

There are **two sets** of material participation rules. A taxpayer who is materially participating for the purposes of self-employment tax may or may not be materially participating for the purposes of passive activity loss rules. The reverse is true: a taxpayer who materially participates for the purposes of passive activity loss rules may not be materially participating for the purposes of self-employment tax.

The Farmer's Tax Guide (IRS Publication 225) lists the tests of material participation of a farm-landlord to determine whether or not self-employment tax must be paid. You are materially participating **if you have an arrangement** with your tenant **and** you meet **one** of the following tests:

Test No. 1. You do any **three** of the following: (1) pay or stand good (e.g., sign for materials bought on credit) for at least half the direct costs of producing the crop; (2) furnish at least half the tools, equipment, and livestock used in producing the crop; (3) consult with your tenant; and (4) inspect the production activities periodically.

Test No. 2. You regularly and frequently make, or take an important part in making of, management decisions substantially contributing to or affecting the success of the enterprise.

Test No. 3. You work 100 hours or more spread over a period of 5 weeks or more in activities connected with crop production. (Note: these numbers do not appear in either the tax code or the regulations.)

Test No. 4. You do things which, considered in their total effect, show that you are materially and significantly involved in the production of the farm commodities.

If you pass the test for material participation you file Schedule F and are subject to self-employment tax on the income. [I.R.C. §1402. Treas. Reg. §1402(a)-4(6) gives six examples]

Material participation for the purposes of passive activity loss rules can be met by passing **one** of the following seven conditions:

(1) The individual participates in the activity for more than 500 hours during the tax year;

(2) The individual's participation in the activity for the taxable year constitutes substantially all of the participation in such activity of all individuals (including individuals who are not owners of interests in the activ-

ity) for the tax year;

(3) The individual participates in the activity for more than 100 hours during the taxable year, and such individual's participation in the activity for the taxable year is not less than the participation in the activity of any other individual (including individuals who are not owners of interests in the activity) for such year;

(4) The activity is a significant participation activity for the taxable year, and the individual's aggregate participation in all significant participation activities during such year exceeds 500 hours;

(5) The individual materially participated in the activity (determined without regard to this test) for any five taxable years (whether or not consecutive) during the ten taxable years that immediately precede the taxable year;

(6) The activity is a personal service activity and the individual materially participated in the activity for any three taxable years (whether or not consecutive) preceding the taxable year (Note: this is a lifetime test, it does not apply to farming); or

(7) Based on all of the facts and circumstances, the individual participates in the activity on a regular, continuous, and substantial basis during the year and for at least 100 hours.

If you pass this test, any losses from the farming business are not limited by passive activity loss rules. [Treas. Reg. §1.469-5T(a)] (Note: If taxpayer is the surviving spouse of a retired farmer the provisions of Treas. Reg. §1.469-5T(h)(2) should be consulted.)

Treatment of Reforestation Costs

Certain reforestation expenses on land held for the commercial production of timber qualify for investment tax credit and amortization over seven years. **Christmas tree production does not qualify**. The limit is $10,000 per year on a joint return and $5,000 per year on a single return. Expenditures must be for site preparation and planting or seeding, including materials, labor, and share of depreciation of equipment. Expenditures for which the taxpayer has been reimbursed under a government cost-sharing program must be excluded unless the government payments are also included in gross income. Most government cost-sharing payments may be excluded from taxable income; however, payments under the Conservation Reserve Program must be included in taxable income. [IRS Publication 535]

Example Woody Forest spent $5,000 on fuel, labor, seedlings, and depreciation to reforest 50 acres. He was approved for cost sharing by ASCS and received 65% of his expenses or $3250. This amount showed on the CCC-1099-G provided to Woody by the ASCS. Woody can exclude from income the greater of the present value of (1) the right to receive $2.50 per acre, or (2) the right to receive 10% of the average income from the land for the previous three years. [Treas. Reg. 16A.126-1(a)]. Since Woody had no income from the land he used (1) and used 8% as the appropriate interest rate in the present value calculation. The value is then $2.50 ÷ 0.08 = $31.25 per acre or $1562 for the 50 acres. Therefore, he figures

Government payment	$3250
Less excludable amount	1562
Amount included in income (Schedule F or C)	1688
Add Woody's share of costs ($5,000-$3250)	1750
Total (enter on Form 3468, line 3)	$3438

Line 3 of Form 3468 instructs Woody to take 10% or $344 as the amount of investment tax credit. The basis for amortization must be reduced by half of the investment tax credit or $172 (½ x $344 = $172).

Total eligible expenses	$3438
Less half of investment tax credit	172
Amortization basis	$3266

Amortization must be taken over seven years using the half-year convention. $3266 ÷ 7 = $467 giving

Year 1	$232
Years 2 through 7	$467
Year 8	$232

The amortization amount is entered on Form 4562 line 39 or 40 and then transferred to ScheduleF line 34 or Schedule C line 27a or write "Reforestation Amortization. See attachment." on Form 1040 line 30 and enter the amount on line 30.

The stewardship incentive program (SIP) has been determined to be substantially similar to the type of conservation, restoration and reclamation programs described in I.R.C. §126(a)(1) through (8) so that §126 improvements made in connection with small watersheds under SIP can be treated in the way described above. The cost-sharing payments are excludable from gross income. [Rev. Ruling 94-27]

Footnotes

Explanation of abbreviations in citations: [I.R.C. §], Internal Revenue Code section number; [LTR], Internal Revenue Service letter ruling; [Rev. Proc.], IRS Revenue Procedure; [Rev. Ruling], IRS Revenue Ruling; [TCM or T.C. Memo], Tax Court Memorandum; [Treas. Reg.] IRS temporary or final regulations.

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Fruit Notes

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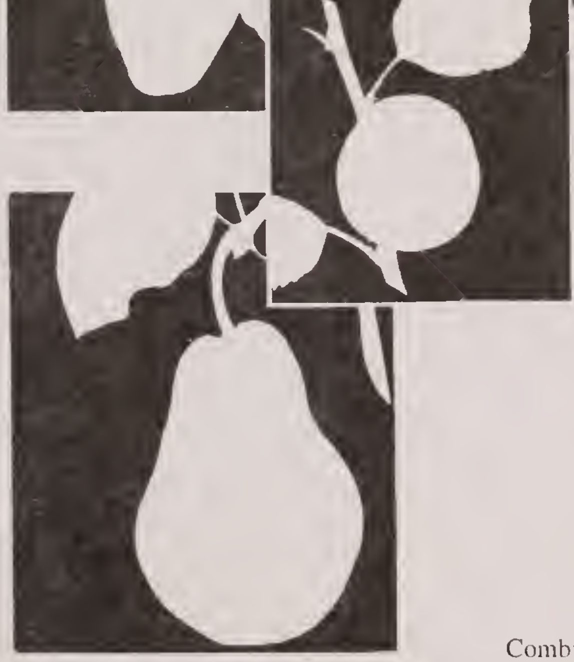

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UMASS EXTENSION POLICY:

Evaluation of Accel® as a Chemical Thinner and Suggestions for Use in 1995

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The chemical thinner Accel® was made available for the first time in 1994. It is an altered Promalin® formulation. Both products contain the same amount of the active thinning ingredient benzyladenine (BA), but Accel contains 1/10 the amount of the other common ingredient, gibberellins A_{4+7}. They are different products and they cannot and should not be used interchangeably.

Last year we outlined the responses one could expect from the use of Accel and made suggestions for the use in 1994 [*Fruit Notes* 59(2):18-20]. Much of the information in that article still is appropriate. The purpose of this article is to review 1994 research results and make revised suggestions for use in 1995.

1993 Thinning Results on McIntosh

A block of Marshall McIntosh/Mark were selected at the Horticultural Research Center in Belchertown. Accel at 20 g a.i./acre and NAA 3 ppm plus 1 lb Sevin 50WP/100 gal were applied when fruit were 10.5 mm in diameter. Temperature at and following application was between 60° and 65°F. A second application of Accel at 20 g a.i./acre was made at 16.2 mm diameter to one group of trees that previously received Accel. Temperature at the time of application was about 60°F. Relative to the control, no treatment caused fruit thinning and no treatment influenced fruit size at harvest (Table 1). The only treatment to increase return bloom in 1994 was Accel applied twice.

Table 1. Effects of 20 g a.i. Accel/acre and 5 ppm NAA plus 1 lb Sevin 50WP/ 100 gal on fruit set, fruit size, and return bloom of Marshall McIntosh apples in 1993.*

Treatment**	Fruit set (fruit/cm^2 limb cross-sectional area)		Fruit size (g)		Return bloom (clusters/ cm^2 limb cross-sectional area)	
Control	8.8	ab	148	a	13.8	b
Accel 10 mm	7.3	ab	158	a	19.8	ab
Accel 10 mm + 16 mm	10.2	a	151	a	23.2	a
NAA + Sevin	6.9	b	161	a	19.2	ab

* Within columns, means not followed by the same letter are significantly different at odds of 19:1.

** Accel concentration = 48 ppm BA.

Weather during thinning time in 1993 was cool and windy. The lack of thinning was not surprising since chemical thinners generally do not perform well when the temperature is cool during and immediately following application. Accel increases cell division and cell number in apples. Thus it can increase fruit size independently of its effects on thinning. In 1993, neither one nor two applications influenced final fruit size. We conclude that warm temperature is required for Accel to increase fruit size as well as to stimulate fruit abscission. Return bloom in 1994 illustrates that Accel has the ability to increase return bloom even if it does not thin.

1994 Thinning Results on McIntosh

Thinning treatments in 1994 were applied to Marshall McIntosh/Mark either at petal fall when the temperature was in the low 70's or at the 10 mm stage

Table 2. Effects of 20 g a.i. Accel/acre, 1 qt Sevin XLR/100 gal, and 5 ppm NAA on fruit set and fruit weight of Marshall McIntosh in 1994.

Treatment*	Fruit set (fruit/cm^2 limb cross-sectional area)	Fruit weight (g)
Petal-fall Application		
Control	8.5	113
Accel	7.3	123
Sevin	7.4	127
Accel + Sevin	5.6	129
10-mm Application		
Control	9.2	116
Accel	7.7	131
Sevin	5.5	143
Accel + Sevin	5,2	157
Accel PF + 10 mm	7.8	131
NAA + Sevin	4.3	144

* Accel concentration = 48 ppm BA.

when the temperature was about 80°F. Petal-fall applications of either Sevin or Accel alone were not very effective, but when combined, they reduced fruit load to an appropriate level (Table 2). Accel application at the 10 mm stage caused only modest thinning, whereas Sevin or Sevin application with Accel reduced crop load effectively. Accel plus Sevin at the 10-mm stage increased fruit size to the greatest extent. The standard thinning treatment of 5 ppm NAA plus Sevin was the most effective thinner, while Accel plus Sevin increased fruit size most. A double application of Accel, at petal fall and again at the 10-mm stage, was no more effective than a single application at either time. Warm temperatures at and following application allowed thinners to work. The best thinning treatment in this experiment was the standard thinning treatment containing 5 ppm NAA plus 1 qt Sevin XLR/ 100 gal. Accel plus Sevin appeared to be a good combination for McIntosh at either petal fall or at the 10-mm stage. For increased fruit size, application of this combination at the 10-mm stage is superior. Accel used by itself is not a potent thinner when sued at the current commercial rates.

1994 Thinning Results with Fuji

A block of six-year-old Akifu #1 Fuji was selected at Chedco Orchard, Berlin, MA. Accel at 20 and 40 g a.i./acre, Sevin XLR at 1 qt/100 gal, and 6 ppm NAA were applied alone and in all combinations at the 10 mm stage of fruit development. Accel alone did not thin (Table 3). Sevin thinned only modestly when used alone, but when combined with Accel it thinned very well, which resulted in a large increase in fruit size. NAA alone did not thin. When combined with Sevin it thinned but fruit size was increased only modestly. When NAA was combined with Accel there was no thinning and there was a dramatic reduction in fruit size. Much of the decrease in fruit size was

Table 3. Effects of Accel at 20 and 40 g a.i./acre, 1 qt Sevin XLR/100 gal, and 6 ppm NAA on fruit set, fruit size, and pygmy formation of Akifu # Fuji apples in 1994.

Treatment*	Fruit set (fruit/cm^2 limb cross-sectional area)	Fruit weight (g)	Pygmy fruit (%)
Control	11.9	169	0.0
Accel 20	12.2	182	0.7
Accel 40	12.6	175	4.6
Sevin	10.6	183	0.0
Accel 20 + Sevin	8.5	215	0.3
Accel 40 + Sevin	6.1	230	0.3
NAA	12.8	164	4.1
NAA + Sevin	7.4	194	5.2
NAA + Accel 20	13.0	153	21.6
NAA + Accel 40	12.3	124	39.4

* Accel concentration: 20 g a.i./acre = 40 ppm BA and 40 g a.i./acre = 80 ppm BA.

due to the increase in pygmy fruit production.

The combination of Accel with Sevin emerged again as a good thinning combination. The combination of NAA with Accel was not acceptable because it increased pygmy fruit formation without thinning. The Accel and NAA combination on Delicious produces a similar undesirable response and thus it is not recommended. We previously have combined NAA and Accel on McIntosh with acceptable thinning and no adverse effects on fruit size or fruit characteristics. As a rule-of-thumb, however, we suggest that Accel and NAA should not be applied together on any apple that has Delicious as a recent parent. Perhaps there are other cultivars that also react adversely to this combination but they are yet to be identified.

Table 4. The relationship between dilute gallonage requirement and Accel concentrations.

Dilute gallonage requirement (gal/acre)	Accel rate (g a.i./acre) 10	15	20	25	30
	(bottles*/acre) 0.5	0.75	1	1.25	1.5
	Concentration (ppm)				
50	53	79	106	132	159
100	26	40	53	66	79
150	18	26	35	44	53
200	13	20	26	33	40
250	11	16	21	26	32
300	9	13	18	22	26

* Accel formulation is sold in 35.6 oz bottles.

1994 Thinning Results with Other Cultivars

Accel did not thin Gala when 37 ppm was applied at petal fall or at 10 mm diameter. Combination of Sevin with Accel did not improve the thinning of Accel. Accel did not improve fruit size. NAA at 6 ppm plus 1 qt Sevin XLR/100 gal severely over thinned Gala.

Accel did not thin Delicious when applied at the 10 mm stage at concentrations between 42 and 84 ppm. The addition of Sevin did not improve the thinning response above Sevin alone. Accel did not increase fruit size.

Suggestions for the Use of Accel in 1995

Accel performed erratically as a thinner in 1994; however, there may be several reasons for this result.

Concentration

There is a large body of experimental evidence gathered over the past 15 years to suggest that the active ingredient in Accel, BA, thins in a linear manner. It is critical to know the concentration being applied and to be aware of the concentration of BA that can cause effective thinning. In general, Accel will not thin significantly at concentrations below 25 ppm. The effective thinning range for easy-to-thin cultivars such as Empire, Idared, Rome, and possibly McIntosh is 50 to 75 ppm. Hard-to-thin cultivars such as Delicious or Golden Delicious may require 75 to 100 ppm.

In 1994 the label limited application of Accel to 20 g a.i./acre or two applications that did not exceed 40 g a.i./acre. The label has been changed for 1995 to allow up to 30 g a.i./acre per application and two applications totaling no more than 60 g a.i./acre. An increase in the amount applied may result in better thinning.

Steps to Determine the Rate of Accel

1. Calculate the tree row volume and dilute gallonage requirement of the block of trees to be thinned.
2. Select the concentration of Accel that is appropriate for thinning the block.
3. Determine if you can apply the concentration required to thin the block and still be within label limits (Table 4).

For example, assume that you have a block of mature McIntosh on M.7 that require 300 gal/acre for a dilute spray. If you put the total amount of Accel in that you are allowed to apply at one time, 30 g a.i. in a tank with 300 gal of water, you will end up with a concentration of 26 ppm, a level near the minimum concentration to get a thinning response. The chances of getting a good thinning response from Accel alone at

this concentration are remote.

Assume now that you have a block of McIntosh on M.26 that require only 150 gal/acre for a dilute spray. If you put the same 30 g a.i. in the tank with 150 gallons of water you will end up with a concentration of 53 ppm. Adequate thinning of easy-to-thin cultivars with Accel alone is possible at this concentration. Following this procedure, orchardists will be able to determine if they are able to obtain adequate results by following label directions.

Double Applications

The label allows two applications of Accel with 30 g a.i. for each application. Research results on McIntosh for two years suggest that two applications are no better than one for thinning. However, return bloom was significantly increased with two applications of Accel in 1993.

Time of Application

Application of Accel at petal fall is not as effective as application at the 10 mm stage. More effective thinning and larger fruit size is achieved when Accel is applied at the later date, when cell division is proceeding at maximum rate and developing fruit are more susceptible to chemical thinners.

Temperature

All chemical thinners are more effective when applied at high temperatures. This maybe particularly true of Accel. Orchardist cannot change the weather; however, it may be possible to select a period of time when temperatures are warm and the chances of getting thinning with Accel are improved. Disappointing thinning can be expected if temperatures at and following application are in the 60's. Acceptable results can be expected when temperatures are in the mid to upper 70's and good results often occur when temperatures rise into the 80's.

Therefore, we suggest that orchardists apply Accel at any time between the 6- and 12-mm stage of fruit development when favorably warm temperatures are predicted for at least three days.

Combination Sprays with Either NAA or Sevin

The most effective thinning treatments have been those in which chemical thinners have been combined. Accel and Sevin have proved to be a very good combination. Accel and NAA have proved to be a very poor combination on Delicious and Fuji. We have combined Accel and NAA on McIntosh and have achieved very good results. Some growers have reported that NAA and Accel worked well on McIntosh in 1994. Proceed with caution with this combination, especially when trying it for the first time on different cultivars, in particular if they have shown a tendency to form pygmy fruit.

There is some reluctance to use Sevin in the thinning program because of the potential to kill mite predators, about which there is a lack of consensus even among experts. The specific predators present in the orchard and the degree of resistance to Sevin by predators must be determined.

Cost of Application

Accel is the most expensive chemical thinner in

Table 5. Estimated cost/acre of applying Accel, Sevin, and NAA alone and in combination to McIntosh apple trees (dilute gallonage requirement of 150 gal/acre) with one or two applications.

	Number of applications	
Thinning treatment	1	2
Accel* 30 g a.i.	$76.28	$152.55
NAA** 7.5 ppm	$5.97	$11.94
Sevin XLR*** 1 pt/100 gal	$4.54	$9.08
NAA + Sevin	$10.51	$21.02
NAA + Accel	$82.25	$164.49
Sevin + Accel	$80.82	$161.63

* Accel 20 g in 35.6 oz = $50.85.

** Fruitone N 1.25 lb container = $26.54.

*** Sevin XLR 1 gal = $24.20. 1 pt XLR = 1 lb Sevin 50WP.

general use today (Table 5). Based solely upon cost, Accel does not appear to be a competitive chemical thinner. However, Accel does have the potential to fruit size in addition to the size effect attributed to thinning. The economic value of apples in large size classes must be considered when selecting a chemical thinner. Cost of the chemical *per se* is not the only factor.

Based upon thinning efficacy and cost, it seems that the most cost-effective way to use Accel may be in combination with other thinners.

Conclusions

1. Apply Accel during the most favorable weather when fruit size is between 6 and 12 mm.
2. Consider petal-fall thinning if weather is favorable. Chances are that you will have a second chance if needed.
3. Warm temperatures are required for Accel to work well.
4. Do not apply Accel alone at a concentration of less than 25 ppm.
5. Consider increasing the activity of Accel by combining it with other thinners.
6. Be careful when combining Accel with NAA. Pygmy fruit or small apples may result. Accel and NAA have worked well on McIntosh.
7. Generally, Accel plus Sevin is a good thinning combination.

Released *Typhlodromus pyri* Show Success in Colonization and Dispersion in Massachusetts Apple Orchards

Xingping Hu, Ronald Prokopy, Starker Wright, and Jennifer Mason
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Phytoseiid mite predators frequently are efficient biocontrol agents against pest mites in apple orchards throughout the world. The phytoseiid predator most prevalent in Massachusetts apple orchards is *Amblyseius fallacis*, found in more than 80% of orchards sampled in a recent survey, but the next most prevalent phytoseiid predator is *Typhlodromus pyri*, which was found in fewer than 10% of orchards sampled [*Fruit Notes* 59(2):10-11]. Our experience with *A. fallacis* over the past two decades is that although it may become highly effective in suppressing pest mites during August and September, it generally is not effective in suppressing pest mites in May, June, or July. There appear to be two principal reasons for this shortcoming of *A. fallacis*. First, according to Jan Nyrop (personal communication) of the Geneva Agricultural Experiment Station in New York, *A. fallacis* is unable to survive winter temperatures lower than about -8_ F. Second, *A. fallacis* are susceptible to several orchard insecticides and fungicides. Even mass-releases of *A. fallacis* in Massachusetts orchards in late June, after most spraying has ceased, have failed to yield effective biocontrol of pest mites.

The experience of Jan Nyrop with *T. pyri* in western New York apple orchards over the past several years indicates that it can survive very cold winter temperatures much better than *A. fallacis* and that it can tolerate several orchard pesticides better than *A. fallacis*. Shortcomings of *T. pyri* are its inability to respond to increasing populations of pest mites as fast as *A. fallacis* can and its inability to spread from tree to tree, block to block, and orchard to orchard as well as *A. fallacis*. Even so, *T. pyri* consistently has proven to be more reliable than *A. fallacis* in providing season-long pest mite control in many parts of the world, including New York, so long as it is sufficiently abundant in early spring and pest mites are not overly abundant at that time.

In one of the 12 second-level IPM blocks that we

Table 1. Average percentage of leaves containing predaceous mites in two blocks in which *T. Pyri* were released.

		Release trees		Adjacent trees	
Release year	Sample year	*T. pyri*	*A. fallacis*	*T. pyri*	*A. fallacis*
1992	1993	0.5	4.0	--	--
	1994	2.0	5.5	0.0	6.0
1993	1993	2.5	7.0	--	--
	1994	11.5	9.5	8.5	11.5

have been studying since 1991, we have found substantial numbers of *T. pyri* and few pest mites during spring. Pest mites usually remain very low until late July, when they begin to increase in numbers but often are controlled efficiently by *A. fallacis* in August. No pesticide except prebloom oil has been required. Therefore, we obtained *T. pyri* from apple trees in Geneva, New York (courtesy of Jan Nyrop) and released them in two second-level IPM orchard blocks in Massachusetts. Here, we report results to date of these releases.

Materials and Methods

The Geneva population of *T. pyri* from which we took individuals for release has a long history of high resistance to Guthion™ and Imidan™, is naturally resistant to Sevin™, and is not affected by benomyl. In 1992, we collected apple tree branches harboring *T. pyri* from Geneva in July and placed them in eight trees in two orchard blocks where *T. pyri* had never been found. In 1993, foliage was collected in Geneva in July. Collected leaves averaged about one *T. pyri* nymph or adult each and were kept in a cooler during transport. Using the suggestion of Jan Nyrop, we stapled 40 collected leaves to 40 attached leaves per orchard tree. We did this on four widely spread trees per block in the same two orchard blocks as in 1992. In August and September of 1993 and September of 1994, we examined 100 leaves from each tree on which *T. pyri* were released. No leaves to which Geneva leaves were stapled in 1993 were taken in the samples. In September of 1994, we also examined 100 leaves from trees immediately adjacent to the release trees.

Results

The results (Table 1) show that *T. pyri* became established in trees on which they were released. In 1992, establishment was poor because of intense rain soon after *T. pyri* release; however, numbers increased four fold in these trees from 1993 to 1994. The 1993 release resulted in relatively low numbers in August and September of 1993, but they increased nearly 5-fold by 1994. Seven of eight trees on which *T. pyri* were released in 1993 harbored *T. pyri* in 1994. The harsh winter of 1993-94 did not seem to have much of a detrimental impact on *T. pyri* survival. In addition, the 1994 samples showed that *T. pyri* had spread in substantial numbers to adjacent trees. In contrast to *T. pyri*, populations of *A. fallacis* on sampled leaves were similar in 1993 and (Table 1

Conclusions

Moving *T. pyri* from infested leaves of a Geneva apple orchard to previously uncolonized blocks in two Massachusetts apple orchards was effective in establishing and spreading this important mite predator, provided that the transferred infested leaves were stapled to leaves of uncolonized trees. Nyrop (personal communication) has suggested an even more effective way of spreading *T. pyri*: picking flower clusters in bloom and using twist-ties to attach clusters to twigs on uncolonized trees. *T. pyri* feed avidly on pollen and seem to aggregate there during bloom. Perhaps the ability of *T. pyri* to survive on alternate food, such as pollen and fungi, in part explains its tendency not to disperse vigorously to previously uncolonized sites. This more sedentary life-style also might explain the tendency of *T. pyri* to be more resistant to orchard pesticides than *A. fallacis*. The strong natural resistance of *T. pyri* to Sevin is an especially positive attribute for growers who desire to use Sevin as a thinning spray. If *T. pyri* were to become established in most Massachusetts orchards, these predators would almost surely provide a substantially, if not fully, effective level of mite biocontrol from early to mid-season and possibly longer.

Acknowledgments

We are most grateful to Jan Nyrop for his insights, encouragement, and assistance.

How Reliable Are Sticky Red Rectangle Visual Traps for Monitoring Leafminer Adults?

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The newly-approved insecticide Provado™ against leafminers offers hope that we now have for the first time an effective and safe leafminer control agent that is not harmful to beneficial predators and parasites. Recent research in New York suggests that a single application of Provado at petal fall may be all that is necessary to prevent leafminer damage throughout the growing season.

Deciding whether or not a petal-fall application of Provado is needed requires estimating the size of the leafminer population prior to the appearance of mines, which usually do not become evident until two or three weeks after petal fall. This means that it is necessary to sample either leafminer adults or eggs prior to petal fall to gain an estimate of population size. New York researchers and extension personnel have long emphasized that monitoring the abundance of eggs will give a more accurate prediction of numbers of mines than monitoring the abundance of adults. We concur with this conclusion; however, our experience has shown that considerable training is required for a grower to be certain of the identity of leafminer eggs, particularly hatched eggs. A much simpler though less accurate method involves sampling the abundance of adults using visual traps. These traps are sticky red rectangles stapled to south sides of apple tree trunks at the green tip stage of bud development.

Here, we present data for four years (1991-1994) during which we counted average numbers of first-generation leafminer adults on trunk traps in blocks of orchard trees and peak numbers of first-generation mines in these blocks. Our intent is to portray the degree of probability with which captures on trunk traps can predict population levels of miners.

Materials and Methods

Our study was conducted in 12 first-level and 12 nearby second-level IPM blocks, each 6-10 acres. At green tip, we stapled a sticky red rectangle (Pest Management Supply Co., Amherst, MA) at knee height to each of five trees per blocks, one near the center of the block and one near each corner. We assessed cumulative numbers of adults captured on traps per block through tight cluster and through pink. We also assessed peak numbers of first-generation mines by sampling 20 leaves on each of 10 trees per block at a time when miner abundance had reached its peak. We excluded all data for blocks in which an insecticide spray was applied against first-generation adults or miners, as such treatment could have altered dramatically the relationship between adults and miners.

We express our findings in terms that the probability of cumulative captures of adults at tight cluster or at pink will predict the need to treat with insecticide before bloom or at petal fall, based on a threshold of seven mines per 100 leaves at the peak of first-generation miners. Put into other words, our findings are presented in terms of the power of trunk traps to predict the need to treat against first-generation adults or eggs to prevent first generation larvae from exceeding a threshold level that could result in eventual crop damage if leafminers were to go untreated throughout the season. The first-generation larval threshold of seven mines per 100 leaves is targeted at McIntosh and is based on an expected eight-fold population increase from first to second generation and a five-fold increase from second to third generation (a 40-fold increase overall, which is characteristic of most years). Our experience

Table 1. Threshold captures of leafminer adults on sticky red rectangle traps at tight cluster or pink as prediction of reaching a threshold level of first-generation larvae.

			Number of blocks where the adult capture threshold was reached		Number of blocks where the adult capture threshold was not reached	
Stage	Year	Number of blocks	Larval threshold was reached	Larval threshold was not reached	Larval threshold was reached	Larval threshold was not reached
Tight cluster	1991	24	5	0	9	10
	1992	5	2	0	0	3
	1993	21	5	0	2	14
	1994	15	2	0	1	12
	Total	65	14	0	12	39
Pink	1991	24	7	0	6	11
	1992	5	2	0	0	3
	1993	21	5	0	3	13
	1994	15	3	2	0	10
	Total	65	17	2	9	37

indicates that 300 mines per 100 leaves (7.5 x 40) during the third generation of leafminers in August can result in 30% or more pre-harvest drop of McIntosh in dry years. Studies prior to 1991 provided data that we used to construct tentative threshold cumulative captures of three adults per trunk trap by tight cluster and nine adults per trunk trap by pink as being thresholds that could translate into seven first-generation mines per 100 leaves.

Results

For a threshold level of **three adults per trap at tight cluster**, the results (Table 1) show that trunk trap captures reaching or exceeding this threshold correctly predicted the need to spray to prevent mines from reaching a threshold of seven per 100 leaves in 100% of cases (14 of 14). Trunk trap captures not reaching this level correctly predicted the need not to spray in 77% of cases (39 of 51). Overall, trap captures correctly predicted the need to spray or not to spray in 81% of cases (53 of 65).

For a threshold level of **nine adults per trap at pink**, the results (Table 1) show that trunk trap captures reaching or exceeding this threshold correctly predicted the need to spray to prevent mines from reaching a threshold of seven per 100 leaves in 88% of cases (17 of 19). Trunk trap captures not reaching this level correctly predicted the need not to spray in 80% of cases (37 of 46). Overall, trap captures correctly predicted the need to spray or not to spray in 83% of cases (54 of 65).

Conclusions

Our findings are encouraging for those who wish to employ trunk trap captures as a method of determining whether or not to spray against leafminers prior to the appearance of miners in leaves two or three weeks after petal fall. The data show that a grower has an 81% probability of making a correct decision using a threshold of three adults per trap at tight cluster and an 83% probability of making a correct decision using a threshold of nine adults per trap at pink. Nearly all failures occur in cases where captures are below threshold and do not correctly predict that mines will reach threshold numbers. This is not a major problem, however, because it would still be possible to treat later against first- or second-generation larvae that exceed threshold levels.

Sticky red rectangles stapled to tree trunks may become increasingly valuable as a leafminer monitoring tool now that Provado is labeled for use against leafminers. For maximum benefit against first-generation leafminers, it is essential that Provado be applied at petal fall (no earlier due to toxicity to bees and no later due to decreasing effectiveness). Waiting to apply Provado against second-generation leafminers will almost surely require two back-to-back treatments to ensure effective control, thereby doubling the cost. If one does not wish to sample leafminer eggs to determine need for a petal-fall Provado treatment, using red rectangle trunk traps is a good next best bet.

Acknowledgments

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Growing Green, Selling Green: A Conference Exploring Green Marketing Trends in the Food Industry

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"Green marketing," the use of environmental philosophy and practice as a marketing tool, is gaining greater acceptance throughout the world. However, the use of integrated pest management (IPM) in a marketing strategy is a controversial issue within the Northeast apple industry. A number of surveys have been conducted in the Northeast to investigate the attitudes toward IPM marketing among consumers, growers, and the food industry (Grant et al., 1990; Hollingsworth et al., 1992; Hollingsworth et al., 1993). To explore further the issues involved in this topic, the University of Massachusetts Cooperative Extension System and the Massachusetts Department of Food and Agriculture co-sponsored a conference called "Growing Green, Selling Green," to bring together leaders of the New England food industry, including farmers, chefs, retailers, wholesalers, and processors with consumer advocates, educators, and government policy makers to discuss opportunities and barriers for marketing produce grown using IPM. The conference was held at Bentley College in Waltham, Massachusetts on November 7, 1994 and included 54 participants from 12 states.

During the morning session invited speakers presented a number of IPM and marketing issues:

Jonathan Healy (Massachusetts Commissioner of Food & Agriculture) challenged the conference by asking what kind of labelling consumers are willing to pay extra for and how we can communicate the concepts of IPM effectively to the consumer.

Jay Hellman (President of John E. Cain Company, Ayer, MA) presented an example of a challenge from the processing industry: selecting pepper varieties for production and processing in Massachusetts.

William Coli (Massachusetts IPM Coordinator) provided an explanation of the components and practices used in IPM, noting that Massachusetts farmers using IPM have reduced their pesticide use by 25% to 70%.

George Dunaif (Campbell Soup Company, Camden, NJ) described how Campbell's uses IPM its system approach (see Bolkan and Reinert, 1994). The company requires the use of IPM by participating growers, but also provides contract growers with significant support, including grower education, pest and weather monitoring, and evaluation of farm practices, coupled with state-of-the-art residue removal processes and pesticide residue evaluation at key stages of production and processing.

James Brienling (Gerber Products Company, Fremont, MI) showed how Gerber uses IPM and a system approach in pursuit of eliminating pesticide residues in its products. The program is based on its Hazard Analysis at Critical Control Points system. Gerber Products provides IPM information to consumers only by request.

Christine Bruhn (Center for Consumer Research, University of California, Davis, CA) presented research results indicating specific consumer concerns with food safety and how consumer confidence in the safety of the food supply can be influenced positively by educational material, in this case, a two-minute video describing IPM practices (Bruhn et al.,1992).

Nathan Reed (Stemilt Growers, Inc., Wenatchee, WA) described two efforts in marketing IPM-grown fruit: the Integrated Fruit Production (IFP) program used in European Union countries and Stemilt's Growers for Responsible Choice (GRC). In 1991, 174,000 acres of

apples in 15 countries were included in IFP certification programs. IFP is supported by European government policies, subsidies, "green" taxes, and "green" marketing, i.e. environmental education.

The Stemilt GRC system rates growers' pesticide use based on efficacy, worker safety, environmental concerns, potential consumer exposure, biological disruption, and effects on beneficial insects and mites. To qualify for the GRC label, pesticide use must score an appropriate number of points. While an assessment of the impacts of the program has not been completed, growers' pesticide use decreased in response to the program. Stemilt GRC-labelled fruit currently are distributed nationally and can be found in Massachusetts stores.

Alan Borst (Rural Development Administration, USDA, Washington, DC) provided an over-view of niche marketing for alternative agricultural products, stating that this market currently includes less than 1% of U.S. food sales, but is growing annually by 20% to 30%. Eighteen large wholesalers were found to market IPM-grown produce in the U.S. Excerpts from the Federal Register during hearings of the Organic Food Production Act of 1990 show that there is little chance of federal standards for IPM-grown produce. The section, "Low Input Label Demonstration Program," was eliminated from the bill.

Julia Freedgood (American Farmland Trust, Northampton MA) provided a national perspective and response to the previous presentations. Freedgood stated that while environmental concerns play an increasing role in the way farmers do business, IPM-marketing could be difficult. American consumers are not well educated about where their food is produced, and while they are concerned with protecting the environment, convenience is a primary factor in selecting food. Nonetheless, IPM-labelling may provide an opportunity to educate consumers about how food is produced and what growers are doing to protect the environment.

Freedgood suggested that reasons to engage in marketing IPM include: 1. educating the public; 2. establishing a growing standard; 3. allowing consumers a choice; 4. recognizing and rewarding IPM growers; 5. encouraging regulatory agencies to consider IPM practices instead of restricting pesticides; and 6. encouraging future cost-sharing programs. Primary challenges to marketing IPM which she identified include: 1. adapting retail systems to another product; 2. educating consumers and retailers; 3. confusing the food safety issue; and 4. confusing the price issue (are premium prices realistic?). She concluded that IPM certification and marketing offer political and economic opportunities that in the long run will exceed the short-run benefits of market premiums.

The afternoon session was composed of structured discussion groups with group members selected by their position in the food marketing system: producers; processors, wholesalers and retailers; representatives of environmental, agricultural, and consumer advocacy groups; and government policy-makers. First, homogeneous groups were asked to identify and rank the benefits and barriers to marketing farmer use of IPM.

The producer group felt that the primary benefit of IPM-labelling was to provide a platform for discussing management practices between producers and consumers, enhancing consumer education and increasing public confidence in grower practices. Another potential benefit was the possibility of increasing market share. Producers also felt that IPM labellingcould identify growers as environmentally proactive, providing them with a larger voice in the regulatory processes, especially those affecting pesticide use. The primary barriers to implementing IPM labelling from the producers' point of view were educational, especially since consumers might perceive products not labelled as IPM as being unsafe. They also were opposed to potential increases in government bureaucracy and regulation. The producers cautioned that IPM labelling might not result in a better price or market share for produce.

Processors, wholesalers, and retailers felt that the primary advantages of IPM labelling were that it distinguished the product as environmentally friendly, and that it educated consumers about how food is produced, thus increasing customer confidence in health and safety and improving relationships among farmers, buyers, and customers. The primary barriers identified by this group are the difficulties in implementing labelling standards, due in part to regional, varietal, and climatic variables. They also cited a general lack of receptivity to labelling by retailers, concerns about verifying producer compliance with IPM standards, and the lack of consumer awareness of IPM.

Consumer, environmental, and agricultural advocates noted that such labelling would help consumers link their behavior with their attitudes, i.e. to vote with their dollars. Labelling also would help to focus policy

needs that would assist farmers in implementing IPM. Labelling also was seen as a vehicle for educating children and providing growers with a way to be environmentally proactive. The concerns of the advocate group included insufficient rewards to farmers, lack of funding for grower education, and resistance by growers. They emphasized the need to educate consumers as part of the whole marketing strategy, not as an "add-on" to other programs, while recognizing the difficulty and expense in trying to explain a complex system adequately. Barriers in the market place included retailer resistance, consumer confusion, and the fact that "IPM," as a phrase, has little market appeal. Regulatory barriers included red tape and costs of implementation, complexity of developing standards, and enforcement.

The government policy group felt that IPM-labelling would build credibility in the food production system, improve competitiveness, and potentially sell more product. Policy-makers felt that the major barriers to IPM-labelling were that the mere mention of "pesticide" on a label may be perceived as negative, that IPM is a difficult concept to convey, and that it brings up the question, "Was the food supply unsafe before?" Additional barriers cited were the difficulties of enforcement and implementation and the costs of implementing a certification program.

The barriers identified above were categorized into common themes, identified as educational, marketing, and policy-related issues. Heterogeneous discussion groups were formed which included representatives from each of the above groups, and each group was asked to propose potential solutions to the barriers within a given theme. Below are the reports provided from each of these groups.

The educational issues group suggested that farmer education should be a coordinated effort of the Northeast regional market. They suggested that more educational materials be developed and that farmer education should be encouraged through some type of reward. Education of retailers and wholesalers should follow a similar path. Consumer education should focus on children, emphasizing a definition of IPM and using a logo with a recognizable symbol (such as a ladybug).

The policy issues group suggested that the IPM-labelling program should be "goal-driven" not "list-driven," that practices, not just farmer knowledge, must be verified and thata labelling program should not add to the burden of the farmer, especially with regard to paperwork. It was suggested that some kind of reward be offered to IPM-verified farmers, e.g. tax relief or guaranteed access to state markets. Policies should support the development of an industry of private consultants and should support marketers by providing funding for labelling and education. While management practices vary among regions, IPM principles are universal. Thus, policy should not be limited to local or state markets, but should be regional, bioregional, or national in scope.

The marketing issues group addressed the problems of developing a larger market share and creating consumer demand. Resistance by retailers to IPM-labelling is due to a lack of educated store personnel and to the logistic problems associated with multiple sources of produce and limited space. The group recommended convening an advisory board of retailers to address these and related issues. Additional problems are largely educational: the lack of consumer awareness of IPM, potential consumer confusion of concepts and labels, and the term "IPM," which provides neither information nor appeal to consumers. The group suggested emphasizing the environmental benefits of IPM and its association with family farms as well as the use of the ladybug as a recognized symbol.

Conclusions

The conference provided a sounding board on the issue of farmers' use of IPM as a marketing tool. Many participants came to the conference with some knowledge of the issues involved in IPM-marketing and preconceived attitudes toward the concept; some supported the concept and some did not. The conference itself did not appear to change attitudes in either direction. There were also a number of participants who had little background in IPM or IPM-marketing. The conference provided these participants with an introduction to the issues.

While participants represented different organizations and many different points of view, a number of common themes were echoed by the participants, principally the need for more public education about IPM. Conference participants indicated that IPM labelling has value as an education tool: to enhance the public's understanding of agriculture, to improve urban-agricultural relationships, and to increase the public's confidence in the food supply. Marketing their use of IPM

provides one method for farmers to participate in the educational process.

References

Bolkan, H.A. and W.R. Reinert. 1994. Developing and implementing IPM strategies to assist farmers: an industry approach. *Plant Disease* 78:545-550.

Bruhn, C., S. Petersen, P. Phillips, and N. Sakovidh. 1992. Consumer response to information on integrated pest management. *Journal of Food Safety* 12:314-326.

Grant, J., J. Tette, C. Petzoldt, and J. Kovach. 1990. *Feasibility in an IPM-grower Recognition Program in New York State*. New York State IPM Program Bull. No. 3.

Hollingsworth, C.S., W.M. Coli, and V. Van Zee. 1992. Massachusetts grower attitudes toward a certification program for integrated pest management. *Fruit Notes* 57(4):7-11.

Hollingsworth, C.S., M.J. Paschall, N.L. Cohen, and W.M. Coli. 1993. Support in New England for certification and labelling of produce grown using integrated pest management. *American Journal of Alternative Agricutlure* 8(2):78-84.

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Performance Over Five Years of Five Rootstock Cultivars in Combination with Five Scion Cultivars in Massachusetts and Maine

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Clearly, the future of the New England apple industry rests with dwarfing rootstocks and high-density plantings, and a major decision that each grower must make is the appropriate dwarfing rootstock to use. To aid in this decision, much research has been conducted on dwarfing rootstocks, particularly by the NC-140 Technical Committee on Tree-fruit Rootstocks. However, much of this research has utilized a relatively small number of scion cultivars, and before selecting a particular rootstock, it is important to understand its performance with the particular scion cultivar of interest. To this end, the NC-140 Committee established in 1990 a trial at 18 locations in the U.S. and southern Canada to study the performance of five dwarfing rootstocks and a number of scion cultivars. In this article, we will detail the results to date from the plantings in Massachusetts and Maine.

Materials & Methods

In May 1990, Smoothee Golden Delicious, Nicobel Jonagold, Empire, and nonspur Law Rome in all combinations on M.9 EMLA, B.9, Mark, O.3, and M.26 EMLA were planted at the University of Massachusetts Horticultural Research Center in Belchertown, Mass. Jonagold on O.3 was missing from the planting. A similar planting was established at the University of Maine Highmoor Farm in Monmouth, Me., except Marshall McIntosh was included as one of the scion cultivars and no trees on M.9 EMLA were planted. Additionally, Golden Delicious on B.9 and Jonagold and McIntosh on O.3 were missing from the Maine planting. Each planting included five replications in a randomized complete block/split plot design. Additional trees were planted at the ends of rows and as guard rows on both sides of the plantings. In Massachusetts, Marshall McIntosh trees on M.9 EMLA, B.9, or M.26 EMLA were planted as a trial with five replications in the guard rows of the larger planting. All trees were staked at planting and were maintained as slender spindles. All developing fruit were removed during the first two growing seasons. All fruit were harvested and weighed in the third through the fifth growing seasons. Trunk circumference was measured each October and used to calculate trunk cross-sectional area. At the end of the fifth growing season, tree height and canopy spread were measured.

Results

In general at these two locations, the effects of rootstock did not vary with scion cultivar; therefore, we will discuss only the overall effects of rootstock or scion cultivar.

Trunk growth varied with rootstock at both locations (Figure 1). After five growing seasons in Massachusetts, trees on M.26 EMLA had the greatest trunk cross-sectional area and those on Mark or B.9 had the smallest. Trees on Mark experienced similar changes in growth rate to those that we have observed previously, i.e. they grew rapidly in the first two seasons when they were not allowed to fruit, after which their

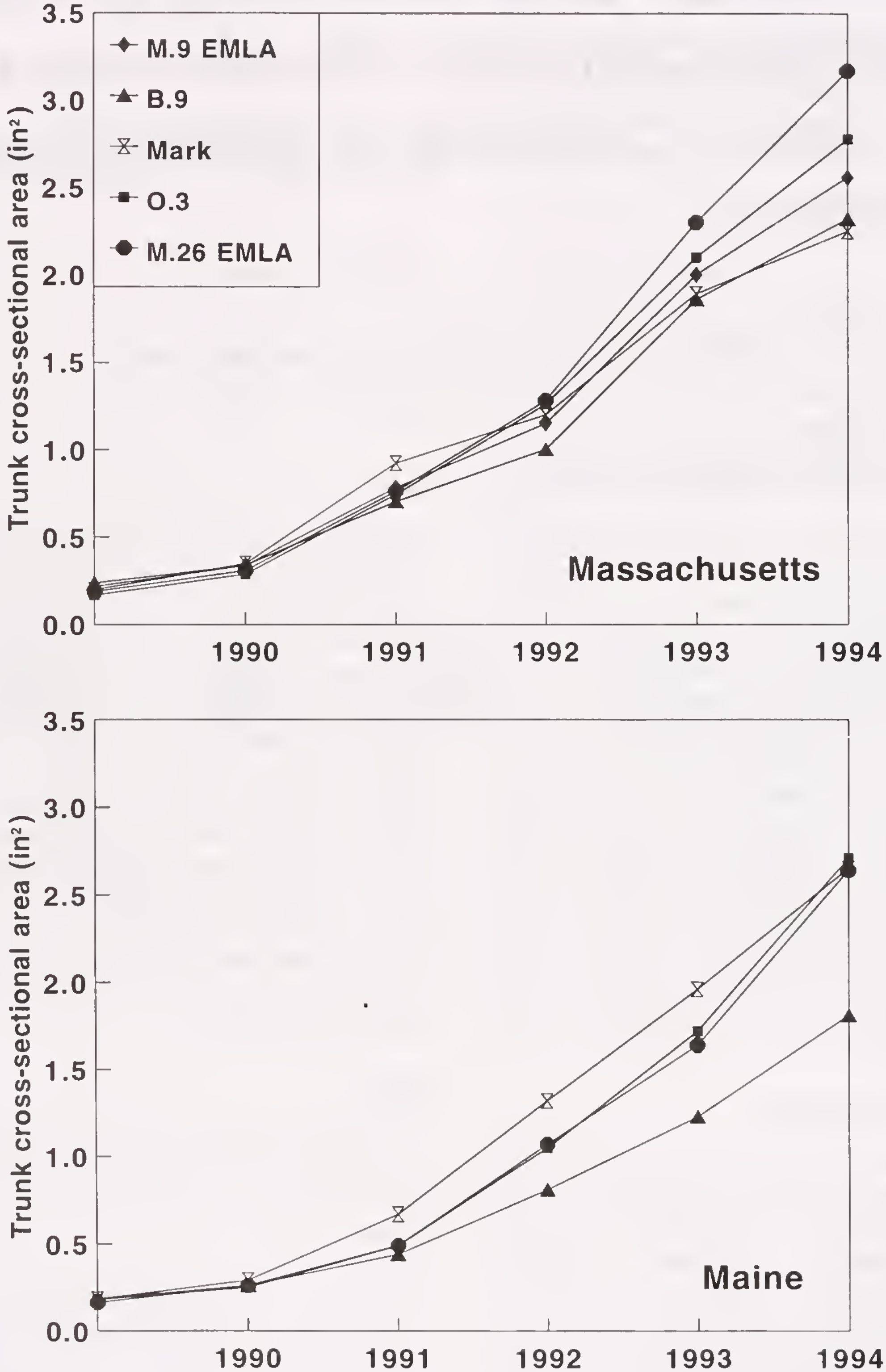

Figure 1. Trunk cross-sectional area from planting though the fifth growing season of trees on various rootstocks in Massachusetts and Maine.

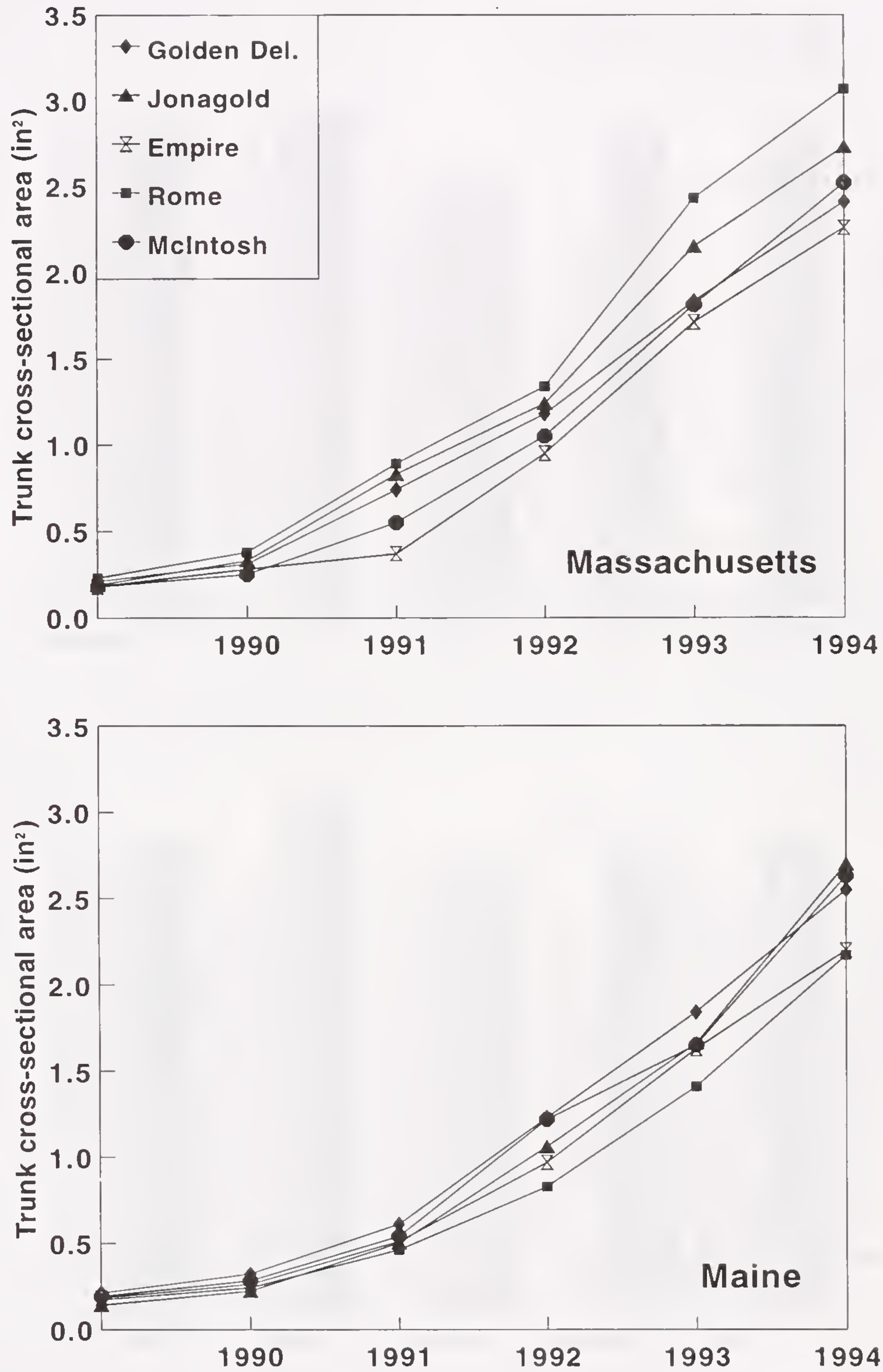

Figure 2. Trunk cross-sectional area from planting through the fifth growing season of various cultivars in Massachusetts and Maine. In Massachusetts, McIntosh trees were not part of the main planting but were planted in the guard rows on M.9 EMLA, B.9, or M.26 EMLA.

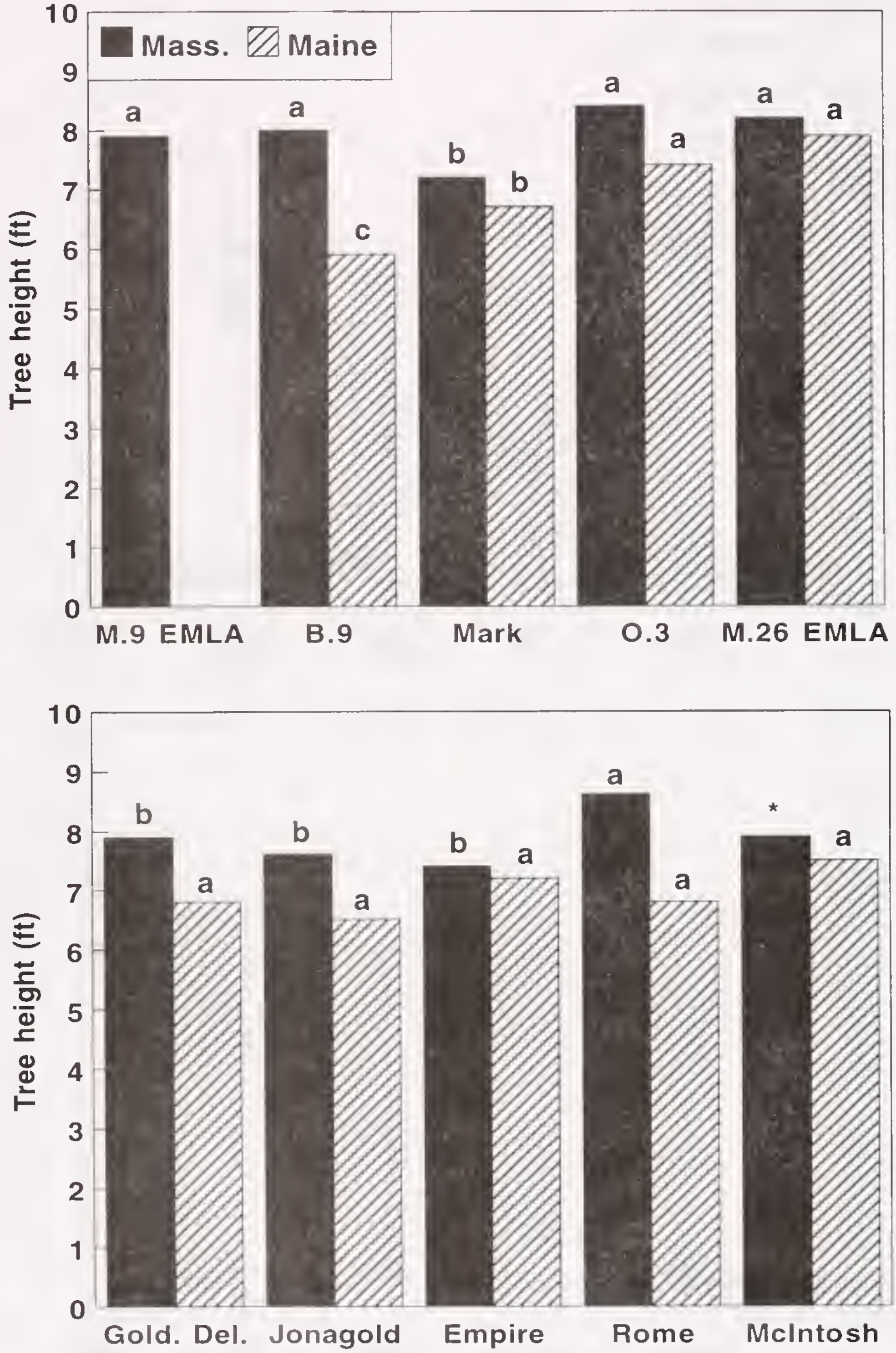

Figure 3. Height after the fifth growing season of trees on various rootstocks or of various cultivars in Massachusetts and Maine. In Massachusetts, McIntosh trees were not part of the main planting but were planted in the guard rows on M.9 EMLA, B.9, or M.26 EMLA. Bars within state that are not topped by the same letter are significantly different at odds of 19:1.

growth rate declined. In Maine, trees in Mark grew more vigorously than the other trees in the first two seasons, similarly to trees on O.3 or M.26 EMLA in the next two seasons, and similar to those on B.9 in the fifth season. Trunk cross-sectional area of trees on Mark, O.3, or M.26 EMLA were similar and significantly greater than that of trees on B.9 at the end of the fifth season.

Trunk growth also varied somewhat with scion cultivar (Figure 2). By the end of the fifth growing season in Massachusetts, Rome trees were larger than Empire or Golden Delicious trees. Jonagold trees were intermediate in trunk cross-sectional area. Although not comparable statistically, McIntosh trees were similar in size to Golden Delicious trees. In Maine, there were no significant differences among scion cultivars with respect to trunk cross-sectional area after five growing seasons.

With respects to tree height after five growing seasons (Figure 3), trees in Massachusetts on M.9 EMLA, B.9, O.3, or M.26 EMLA were similar and significantly taller than those on Mark. In Maine, trees on M.26 EMLA or O.3 were the tallest, followed by those on Mark. Trees on B.9 were the shortest. Scion cultivar did not affect tree height in Maine, but in Massachusetts, Rome trees were taller than all other trees.

Canopy spread was affected by rootstock in both locations (Table 1) and was very closely related to differences in trunk cross-sectional area. Specifically, trees on O.3 or M.26 EMLA had the greatest spread in Massachusetts and those on B.9 or Mark had the least spread. In Maine, canopy spread of trees on Mark, O.3, or M.26 EMLA was similar and significantly greater than that of trees on B.9. Scion cultivar did not affect spread in Maine, but in Massachusetts, the canopy spread of Empire trees was significantly greater than of other scion cultivars.

Yield can be measured in various ways (Figure 4): per tree, per trunk cross-sectional area, or per acre. Per tree in Massachusetts, those on M.9 EMLA, B.9, Mark, or M.26 EMLA yielded similarly for the period from 1992 through 1994. Only trees on O.3 yielded more. In Maine, trees on Mark yielded the most and those on B.9 or M.26 EMLA yielded the least over the same period. In Massachusetts, Rome trees yielded the most and Empire trees yielded the least. In Maine, all scion cultivars yielded similarly per tree.

Table 1. Measured canopy spread and calculated tree densities of five rootstocks and five scions in Massachusetts and Maine. In-row spacing was calculated as 80% of the tree spread after five years, and seven feet were added to the in-row spacing to obtain the between row spacing.*

	Canopy spread (ft)		Calculated density (trees/acre)	
Treatment	Mass.	Maine	Mass.	Maine
M.9 EMLA	8.7 bc		460	
B.9	8.5 c	6.2 b	501	777
Mark	7.9 c	7.2 a	537	608
O.3	9.6 ab	7.6 a	407	574
M.26 EMLA	9.9 a	7.2 a	393	658
Golden Delicious	8.6 b	6.7 a	474	632
Jonagold	8.8 b	7.3 a	464	654
Empire	9.5 a	7.7 a	439	592
Rome	8.7 b	6.3 a	472	761
McIntosh	8.5 **	7.3 a	484	615

* Within rootstock or scion and within column, means not followed by the same letter are significantly different at odds of 19:1.

** McIntosh data from Massachusetts were not compared statistically, since trees were not replicated within the experiment, but were planted as part of a guard row.

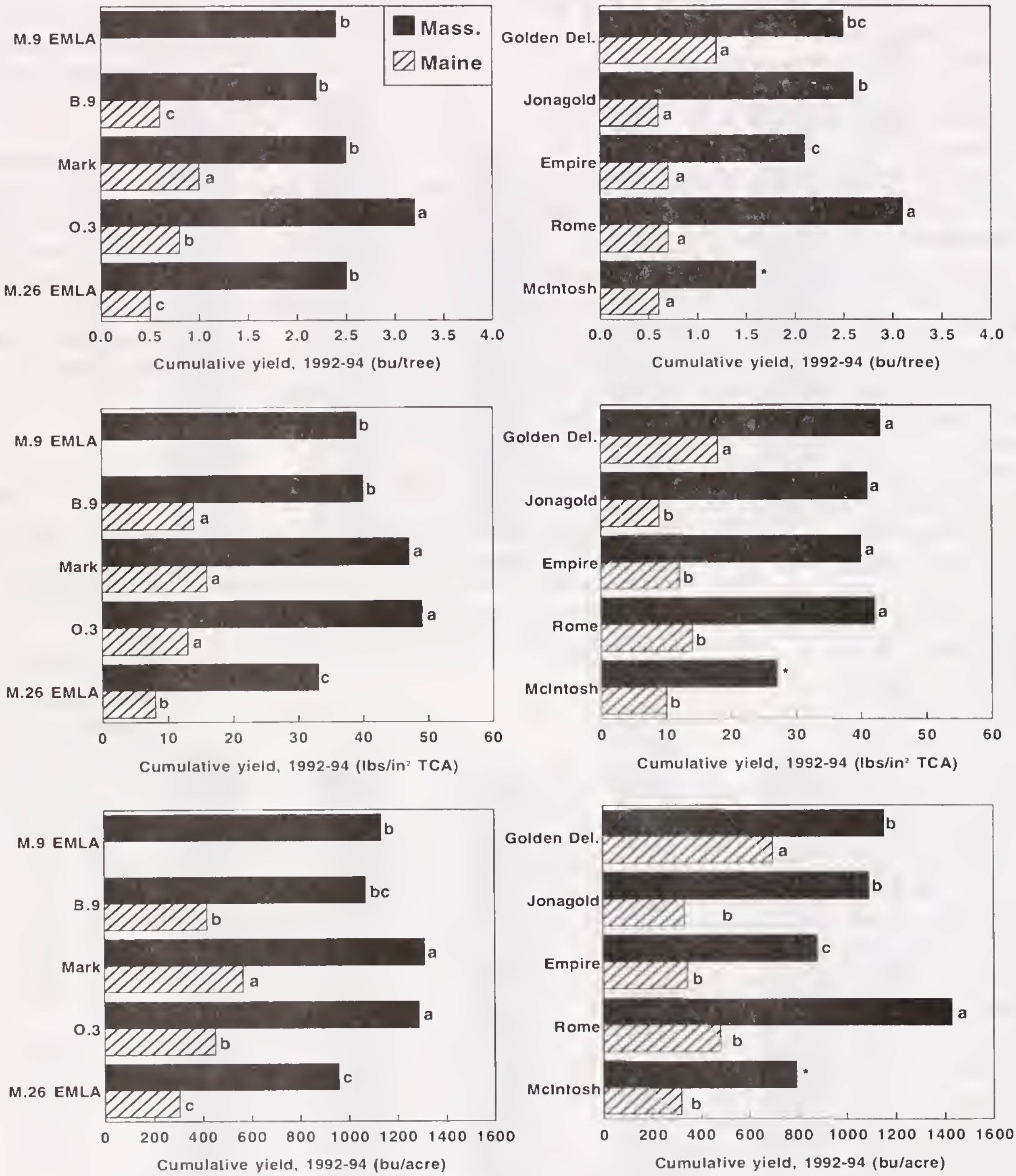

Figure 4. Cumulative yield per tree, per trunk cross-sectional area, and per acre of trees on various rootstocks or of various cultivars in Massachusetts and Maine. In Massachusetts, McIntosh trees were not part of the main planting but were planted in the guard rows on M.9 EMLA, B.9, or M.26 EMLA. Bars within state that are not followed by the same letter are significantly different at odds of 19:1.

Yield per unit of trunk cross-sectional area (or yield efficiency) is a way to relate yield to tree size and possibly compare commercial yield potential. Using this measurement (Figure 4), trees on Mark or O.3 yielded the most and those on M.26 EMLA yielded the least in Massachusetts. In Maine, trees on B.9, Mark, or O.3 yielded similarly and significantly more than those on M.26 EMLA. In Massachusetts, the four scion cultivars in the study yielded similarly. McIntosh appeared to yield less, although it is not directly comparable. In Maine, Golden Delicious trees yielded significantly more that the other scion cultivars.

Clearly the best way to compare yield performance would be to compare actual yields per acre. In a study such as this one, per-tree yield and per-trunk-cross-sectional-area yield can be measured directly; however, sufficient land and labor is not available to establish and maintain an experiment that could be used to compare actual yields per acre. Therefore, per-acre yield must be calculated from per-tree yield and an estimate of tree density per acre. Table 1 gives estimates of tree density based on canopy spread, assumingthat in-row spacing should be approximately 80% of the canopy spread after five years and that seven feet should be added to in-row spacing to obtain an appropriate between-row spacing. Clearly, this is an imperfect measure of yield because it is based on estimates of density rather than trees actually planted at those densities, but it allows comparison of an actual performance measure. Using this measure (Figure 4), trees on Mark and O.3 yielded the most and those on M.26 EMLA yielded the least in Massachusetts. In Maine, trees on Mark outyielded the others and trees on M.26 EMLA yielded the least. In Massachusetts, Rome tree yielded the most and Empire trees yielded the least. In Maine, Golden Delicious trees yielded more than all others.

Tree size and yield are not the only measures of tree performance. Fruit size also is a very important parameter. Fruit size was measured each fruiting year of this study. These data are presented in Table 2 as counts per 42-lb box. Rootstock did not affect fruit size; however, cultivar differences were dramatic, as would be expected. Rome and Jonagold trees produced the largest fruit and Empire trees produced the smallest.

Another interesting comparison that we have not yet discussed is the difference between the two sites. As we have seen with other plantings, trees in Massachusetts were larger after five years (Figures 1, 2, and 3 and Table 1). They also yielded more (Figure 4). Overall, trees in the Maine planting appear to be one year behind those in Massachusetts.

Conclusions

This article presents only the preliminary results from this study. The study will continue for another five years, giving a detailed picture of these scion cultivars on these rootstocks. After five years, however, it is possible to make some generalizations about rootstock performance. Specifically, the largest trees among these rootstocks will be on O.3 or M.26 EMLA. The smallest trees will be on B.9 (or possibly Mark). Trees

Table 2. Size of fruit (as counts per 42-lb box) from trees on five rootstocks or with five scions in Massachusetts and Maine.*

Treatment	Mass.	Maine
M.9 EMLA	89 a	
B.9	91 a	131 a
Mark	94 a	119 a
O.3	97 a	115 a
M.26 EMLA	88 a	120 a
Golden Delicious	101 b	127 bc
Jonagold	77 a	113 b
Empire	118 c	141 c
Rome	71 a	91 a
McIntosh	107 *	134 c

* Within rootstock or scion and within column, means not followed by the same letter are significantly different at odds of 19:1.

** McIntosh data from Massachusetts were not compared statistically, since trees were not replicated within the experiment, but were planted as part of a guard row.

on M.26 EMLA will be the least productive and those on O.3 or Mark will be the most (on a commercial basis). Finally, for trees on any of these rootstocks, fruit size will be good.

Rootstock evaluations which compare the relative differences related to rootstock with different scion cultivars are important. Although this study did not show any significant variation in rootstock effects from scion cultivar to scion cultivar, the whole study (over 18 sites) does show some variation. Other studies also have shown some significant variations, partially related to incompatibilities. We have two other cooperative projects dealing with the potential for the interaction between rootstock and scion cultivars. One was planted in 1991, again in Belchertown, Mass. and Monmouth, Me., including Pioneer Mac, Marshall McIntosh, Rogers Red McIntosh, and Chic-a-dee McIntosh on M.7 EMLA, Mark, M.27 EMLA, or M.26 EMLA. The second will be planted in Belchertown and Monmouth this spring and includes Rogers Red McIntosh, Pioneer Mac, Cortland, and Macoun on B.491, B.146, P.2, P.22, V.1, V.3, B.469, P.16, B.9, M.9, M.9 NAKBT337, or Mark. These studies should help growers select the best rootstock for the scion cultivars grown locally.

Fruit Notes

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UMASS EXTENSION POLICY:

The Cool Late-summer Temperatures of 1994 Did Not Change Scald Susceptibility of Apples in Massachusetts

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In *Fruit Notes* [59(3):6-10], we presented typical relationships between scald susceptibility of Cortland and Delicious apples in Massachusetts (Figure 1). In both cultivars, susceptibility drops rapidly as fruit experience preharvest hours below 50°F. If Cortland are

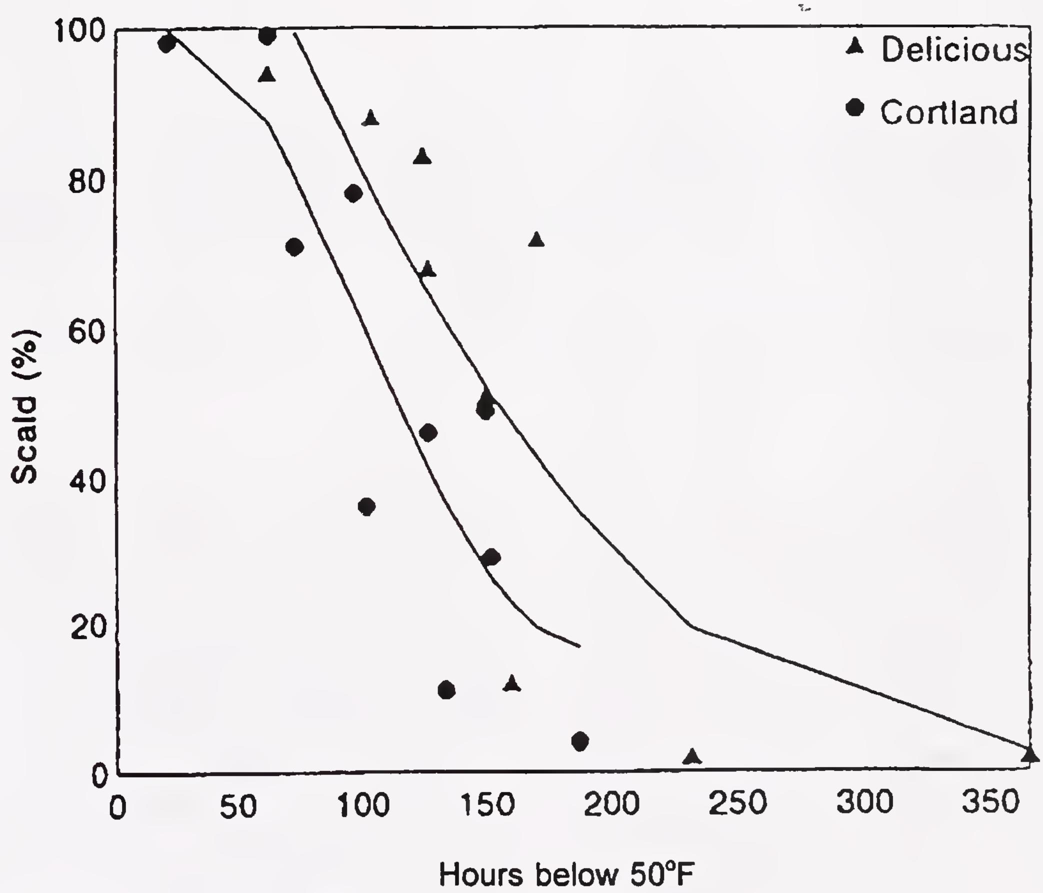

Figure 1. Calculated changes in scald susceptibility (percent of fruit that develop scald after storage) with increasing hours below 50°F between August 1 and fruit harvest date.

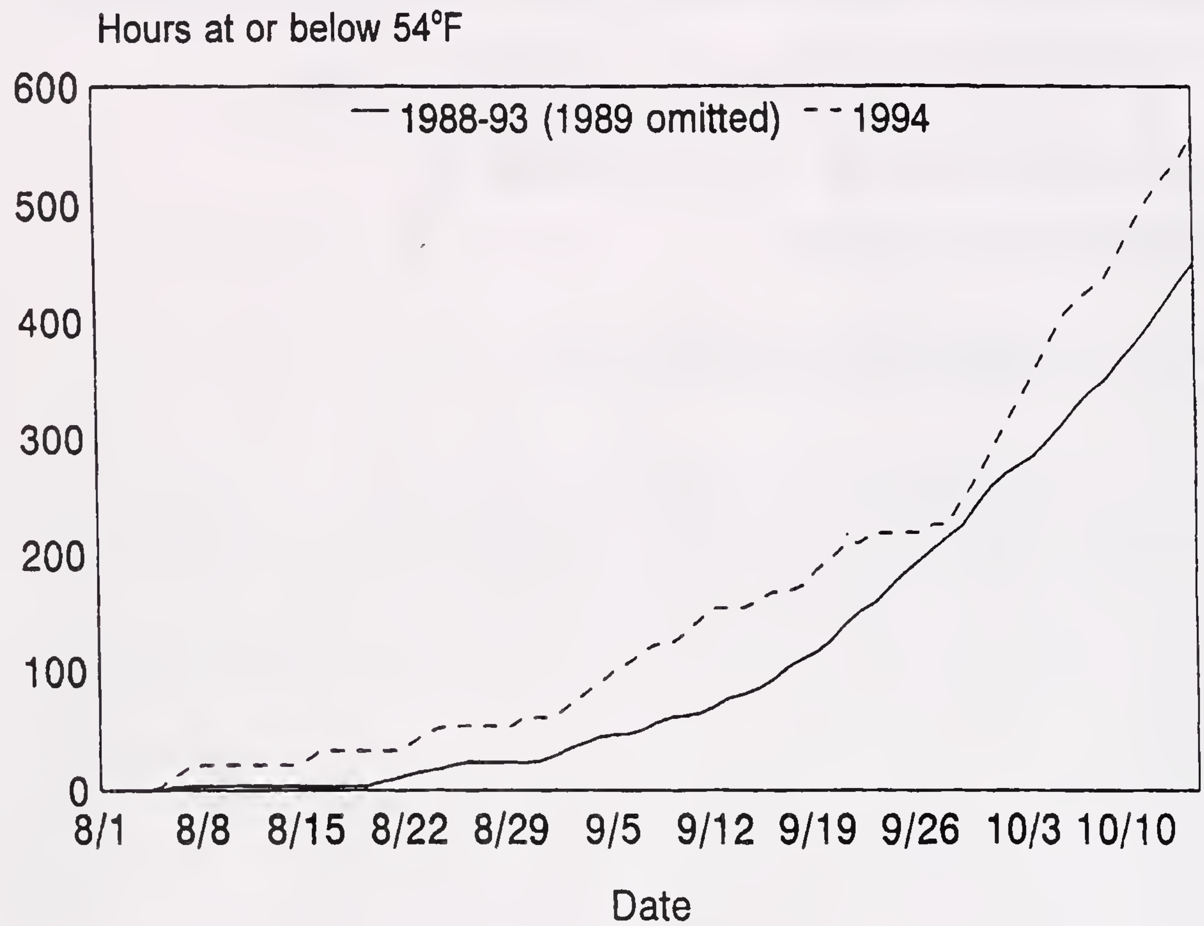

Figure 2. Cumulative hours below 54°F from August 3 to October 15 in 1994 vs. the average of five preceding years.

picked before they have experienced about 75 hours below 50°, you can expect that close to 100% of the fruit will scald after long-term air storage. However, if they have experienced more than 75 hours below 50°, their susceptibility to scald has fallen, and by 200 hours below 50°, less than 20% of the fruit are likely to scald. For Delicious, about 100 hours below 50° are required for susceptibility to decline, but by 250 hours, less than 20% of the fruit should develop scald without any scald-prevention treatment. This pattern has been consistent since we began collecting data in 1986.

In 1994, late Summer and early Fall were unusually cool. However, temperatures did not fall below 50°F any earlier than usual, and once they did, hours below 50° did not accumulate any more rapidly than usual. The unusually cool temperatures involved many hours in the low 60's and the 50's. The question was, did the unusually large number of hours in the 50's in late Summer have a significant effect on the typical temperature-scald relationship seen in Figure 1? We suspected that they would.

We begin counting hours below 50°F on about August 1. The unusual coolness in 1994 is illustrated in Figure 2, as the accumulated hours below 54°F, in comparison with the average of the preceding years.

On September 28 and again on October 4 and 7, we harvested one-bushel samples of apples from each of five trees of Cortland and

of Delicious. These fruit were stored for 29 weeks at 32°F and then kept at 70°F for seven days, after which the percent of fruit that had developed scald was determined. Results (Table 1) show that actual scald development in 1994-95 was about the same as would be predicted from Figure 1, based on hours below 50°F at harvest. Therefore the unusually cool season had no substantial effect on scald susceptibility other than what would have been detected by counting hours below 50° before harvest.

Table 1. Comparison of scald development on Cortland and Delicious apples in 1994-95, with scald incidence predicted from regression on hours below 50°F in historical data from Belchertown, MA.

Harvest date	Starch score	Hours below 50°F	% Scald Predicted	% Scald Actual
		Cortland		
9/28	4.3	101	60	68
10/4	5.7	168	20	46
10/7	6.1	224	18	26
		Delicious		
9/28	2.9	101	100	66
10/4	3.3	168	45	49
10/7	3.9	224	20	32

Note: In this experiment we determined scald on fruit when they were removed from storage, as well as after seven days at room temperature. The percent of Delicious with scald on them was as high right out of storage as after seven days at room temperature, although the scalded areas were darker in color after the seven days. Thus, scald actually formed in storage. This was not true for Cortland. Very few of them showed scald at removal from storage; most scald appeared during the seven days at 70°F. It should be pointed out that these fruit were kept in 32°F air for 29 weeks and so, they were very senescent. We do not know if the scald on Delicious would have been as fully developed at removal from storage at earlier times.

* * * * *

Developing Apple Trees in the Super Slender Spindle System

Ronald Perry
Department of Horticulture, Michigan State University

The Super Slender Spindle (SSS) system is one of the newest systems to reach North America. It was developed several years ago in Germany and in Holland, where growers wanted to produce the most fruit possible and in the shortest time period following planting on small land holdings. Argument still lingers as to its specific origin. Most attribute its start on the German side of Lake Constance, where several growers working with Fleuren Nursery in Holland began planting trees on top of the soil (known then as the Bodenzee system) at a spacing of one to two feet by eight to ten feet. The purpose then of planting on top of the ground was to use stress to assist in canopy vigor control. Since then, newer plantings have tended towards planting stocks in the soil.

Initially, low priced lower quality trees were planted in a four- to five-wire vertical trellis, kept to a height of eight to nine feet. Today, most new plantings have incorporated a T brace with two outrigger wires and alternate trees leaned at 15 degrees from vertical to encourage better light penetration. Trees in the SSS typically are planted at 2000 to 5000 trees per acre. One of the primary constraints to this endeavor is the total cost of trees and of trellis materials per acre (Table 1). This is one reason why those who want to try this system should contemplate finding a way to reduce tree cost (or own a bank). Some have reduced tree costs by making their own trees, and other have tried planting "sleeping eye" trees (*Great Lakes Fruit Growers News*, November 1994, p. 63). Also, the trellis system is expensive (Table 1) and must be strong enough to support fully the trees and the crop. There are only a few orchards that have begun trying the SSS, so there is limited experience. The oldest trees in North America on this system can be found in British Columbia, where there are four- to six-year-old orchards.

The greatest challenge to the grower is in avoiding shading problems caused by inadequate vigor control, especially after the fourth year. Trees are not pruned during the dormant season and more time is spent summer pruning to control canopy growth. Additionally, some experienced growers are experimenting with applications of ethephon and NAA to aid in growth regulation. Growers are being taught by European consultants to rip, tear, or break branches with their hands for summer pruning rather than using shears. Apparently, the wounding stresses branches and decelerates growth. This process is very quick, where vigorous upright growth is torn off.

This system is very challenging and less forgiving for the grower then other systems. Much time and labor is spent on vigor control and the system is likely not to exceed a life of 10 years. It has the advantage of producing large quantities of fruit in the early years. Remember that production in the first six to seven years in these high density systems is directly related to the number of trees planted per acre. We established a small row of Bodenzee trees in 1992 (1.5' x 14') of Smoothee Golden Delicious on various M.9-style stocks and found cropping per tree in the third year to be slightly less than for trees on the same stocks in the HYTEC (*Great Lakes Fruit Growers News*, May 1995, p. 25). If we had planted a full acre of these trees on M.9 NAKB T337 (12 pounds in 1994) at a 1.5' x 10' spacing, we might have reached production at 830 bushels. Many of these trees had three to five pounds of fruit per tree in the second sea-

Table 1. Estimated cost per acre of materials in establishing two different designs of the Super Slender Spindle trellis.

Item	Quantity needed	Vert. trellis (2904 trees/ acre)	Vert. trellis (4356 trees/ acre)	"V" trellis (4356 trees/ acre)
Line posts, 4" x 12', 50' interval	90	$ 900.00	$ 900.00	$ 900.00
Anchors, 4" x 8', 9 rows	18	$ 90.00	$ 90.00	$ 90.00
Stakes, 1/2" bamboo				
spacing = 1.5' x 10'	2904	$ 1,161.00		
spacing = 1.0' x 10'	4356		$ 1,743.00	$ 1,743.00
Wire, 9 rows x 500' x 4 strands	18000'	$ 270.00	$ 270.00	
Wire for V system, 5 strands	22500'			$ 337.50
Wire tensioners	36	$ 108.00	$ 108.00	$ 108.00
Wire clips, tape, and other supplies		$ 300.00	$ 300.00	$ 300.00
T Brace materials for V system				$ 300.00
Trees (@ $5/tree)	2904	$14,520.00		
	4356		$21,780.00	$21,780.00
Total not including labor		$17,349.00	$25,191.00	$25,828.00
Adjusted total if trees cost $2.00		$ 8,637.00	$12,123.00	$12,760.00

son (the HYTEC and Guttingen V trees had nofruit).

Remember that the philosophy in this system is to maintain a canopy of temporary branches. Unlike the Vertical Axe and the Slender Spindle at wider spacings, no permanent branch system is maintained. Therefore, a branch is removed once it has borne fruit for one to two seasons. Any strong branches lacking in fruit are not allowed to stay.

Fireblight

This system has many drawbacks. Establishment cost is the primary problem in the SSS. Additionally, the system depends on intensive and frequent summer pruning to keep the canopy vigor under control. Growers attempting this system will find that the practice of ripping and tearing off branches is in direct conflict with suppression of the spread of fireblight (FB). Dr. Paul Steiner at the University of Maryland contends that bacteria reside on the surface of bark and that it can readily enter the vascular system in wounds such as those developed through the ripping or tearing process. This happens frequently in the Midwest and east following a hail storm. Sterilizing equip-

ment or gloves will not avoid spread without also sterilizing the bark on branches. Also, the sterilization process may be ineffective because the bacteria may already be in the vascular system. He suggests that growers hold off any summer pruning, especially with FB susceptible cultivars like Gala, Jonagold, and Fuji, until after the FB season passes. This likely would be in July and August when conditions are dry and FB strikes are less active. Another approach is to employ the "ugly-stub" cut in the removal of two-year-old wood, leaving a four to five inch stub (P. Steiner, personal communication). Additionally, we are experimenting with the use of other methods to control vigor such as growing trees on a fabric similar to a landscape weed mat to constrict rooting. Root pruning may also be a viable option to control vigor in conjunction with late summer pruning.

Support

The best time to install a support system is as soon as possible after the trees have been planted. Do not delay in installing at least the stakes. The support that they provide will ensure maximum growth. It is recommended that growers consider the use of individual 1/2" bamboo stakes for each tree in addition to four wires. However, I have seen many growers attempt to reduce costs and not use individual stakes. We have done this and found at this point that the wires are sufficient support. Wires should be strung at heights of 24", 44", 64", and 84". Without bamboo stakes, more time will be spent trying to tie trees to wires snugly enough to prevent lateral slippage down the wire. Establish a line post every 50 feet with adequate end posts.

Plant so that the union is set within a minimum of four inches above the soil line for mechanically planted trees and a minimum of six inches above in augured holes. Prune the leader 12 inches above the uppermost feather (a branch at least 10 to 12 inches long). Some growers have had good experience with not pruning the tree at planting. Instead, bend the stem to induce branching. Remove any feathers that arise from below 24 inches on the leader. Do not whip trees. Keep all branches except those that are more than one half the diameter of the stem.

First Growing Season

- At three to six inches of growth, clothes pin the new laterals to a flat angle.
- Attach leader to metal tube, stake, bamboo, or wires (directly) every 18 inches with plastic tape (Max Tapener). Snake or bend leader in June if cultivar does not branch readily (e.g. Empire).

Second Growing Season

- Do not prune in winter. Keep terminal bud intact. For more vigorous canopies, snake or replace leader in July.
- In June, remove fruit on leader and one-year-old wood, and single fruits on spurs spaced six inches apart.
- In July, break or remove vigorous non-fruiting branches with hands to tear tissue. This needs to be done 2-4 times through first couple weeks in August. Avoid if FB is apparent and if weather indicates high risk for FB spread, especially for FB-susceptible cultivars, particularly in FB strike season.

Third Growing Season

- In June, thin to six-inch spacing for fruits.
- In July, break or remove vigorous non-fruiting branches with hands to tear tissue. This needs to be done two to four times through the first couple of weeks in August. Avoid if FB is apparent and if weather indicates high risk for FB spread, especially for FB-susceptible cultivars.

Fourth Growing Season

- In winter, concentrate on removing vigorous growth which is more than one half the

diameter of the leader. Remove uprights. Select new laterals or leader. If the top is vigorous, accomplish this task in late June or early July.

- Follow third growing season steps.
- For trees with the ultimate height of six to seven feet, more snaking and lateral branch replacement of the leader must be done, especially on vigorous trees, in order to reduce tree vigor and keep height under control.

This article was modified from one that appeared in Great Lakes Fruit Gowers News, *June 1995, p. 28.*

* * * * *

Summer Pruning Increases Pesticide Coverage in Apple Canopies

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In previous articles, we have described reductions in flyspeck as a result of summer pruning of dense apple canopies. The reductions depend to some extent on changes in relative humidity, drying time, and perhaps temperature in the apple canopy brought about by summer pruning. We know this because there is as much as 50% less flyspeck in summer-pruned canopies even when no summer fungicides are applied.

However, in spite of bringing about significant reductions in the amount of disease, summer pruning alone does not control flyspeck adequately. Summer fungicide applications are necessary to keep the disease at commercially acceptable levels in many orchards. We expect that summer pruning may interact with fungicides in terms of flyspeck incidence, and that less fungicide may need to be applied in a summer-pruned orchard compared with a non-pruned one. We hypothesize that the reduced disease pressure brought about by the change in canopy microclimate may require less fungicide to manage the disease, either in terms of a lower rate of fungicide per application or less frequent applications. In addition, summer pruning probably improves penetration of fungicide into the canopy. As a first step toward investigating the interaction of summer pruning with fungicide applications, we investigated the effect of summer pruning on spray deposition in the canopies of semi-dwarf apple

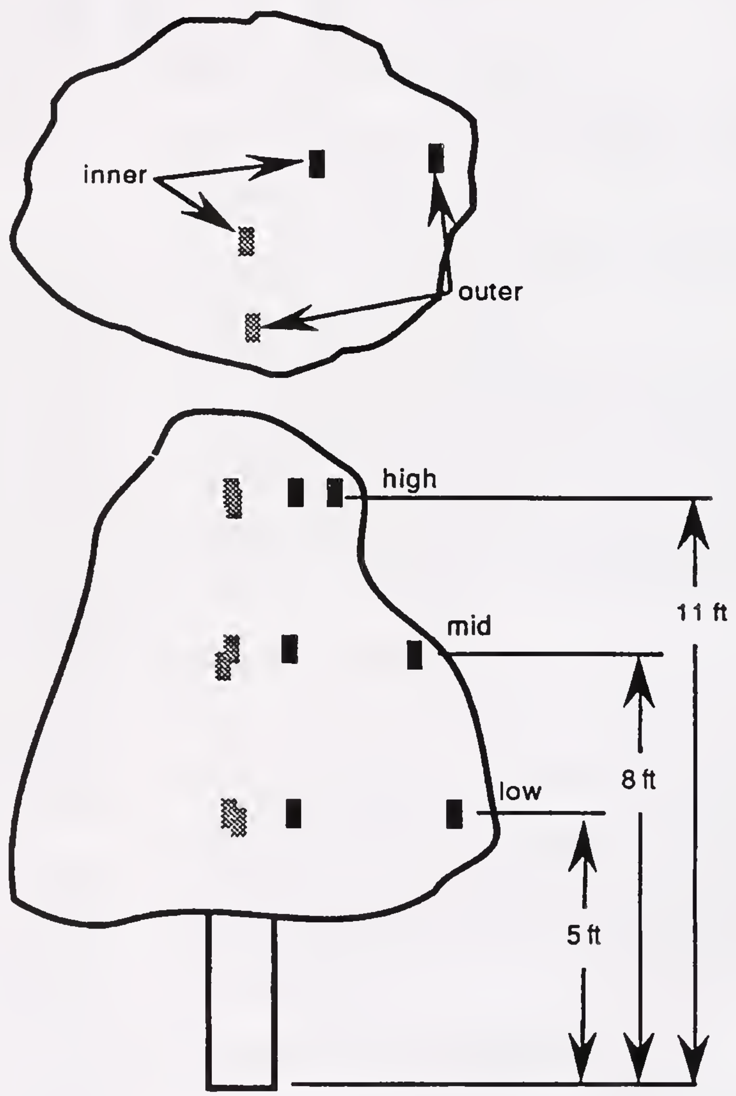

Figure 1. Placement of water-sensitive paper targets in apple trees.

trees.

We selected a set of 10 mature McIntosh/ M.7 trees, spaced 20 by 30 feet, approximately 12 feet tall, with dense canopies. Trees were divided into five pairs. One of each pair was summer pruned on July 19 or 20,1994, while the other was not pruned. A week later we hung water-sensitive papers, or targets (1 in x 3 in), on terminals in each tree. The papers turn from yellow to blue wherever water contacts the paper, and therefore will show the pattern of spray deposition where they are hung. The papers were hung in a specific pattern in each tree, as shown in Figure 1. The height locations were designated "low", "mid", and "high", corresponding to 5, 8, and 11 feet, respectively. Depth locations were designated "inner" and "outer", corresponding to less than two feet from the trunk and less than one foot from the end of the outermost branches, respectively. One target was placed at each location, both perpendicular to the row and in line with trunks in the row. Hence, each tree had a total of 12 targets.

After we hung the targets, an air blast sprayer delivering 140 gal/A and traveling at 2.5 mph applied water to the trees. Patterns such as those shown in Figure 2 developed on the targets. In order to measure accurately the amount of spray deposition on the targets, we created computer images of each target and measured the percent of a 1 in x 1.5 in rectangle which had been darkened. The spray deposition patterns were digitized using a flatbed scanner. Then, digitized images were analyzed using public domain image analysis software (NIH Image 1.55) on a personal computer.

The only positioning factor which significantly affected spray deposition was height (Figure 3). Percent coverage of targets at the five-foot level averaged 77%, while coverage at eight feet averaged 47%, and that at 11 feet averaged 34%. The experiment also confirmed our hypothesis that summer pruning enhanced coverage, i.e. 60% and 46% coverage for summer-pruned and non-pruned trees, respectively. While the interaction between height and pruning was not significant, it was apparent that the differences occurred primarily in the middle and upper canopies.

These findings have some practical implications. First, many problems with spray coverage occur in the tops of relatively tall trees. As the data show, deposition in the upper canopy

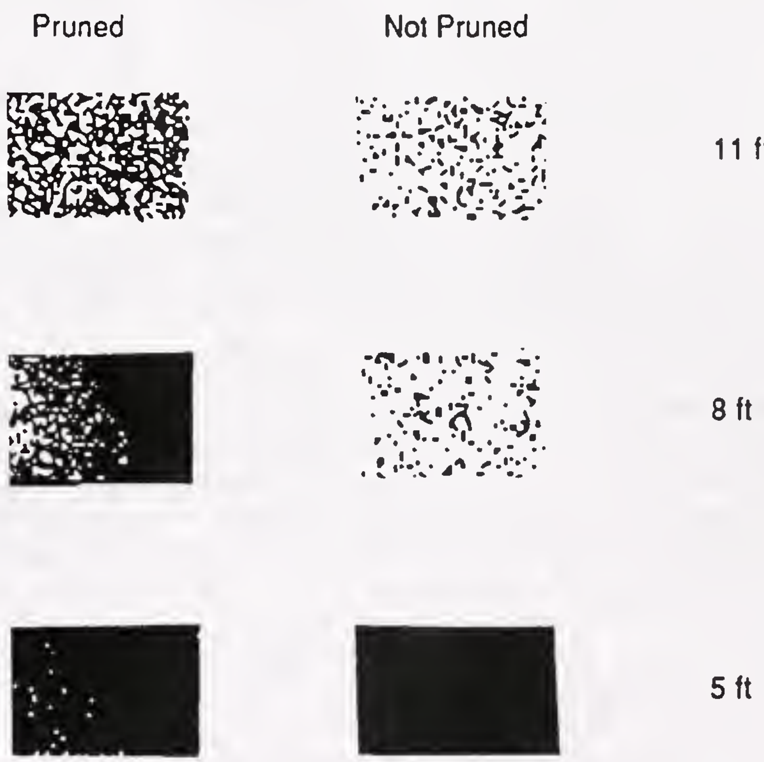

Figure 2. Typical spray patterns on water sensitive paper placed in the outer canopies of pruned and non-pruned apple trees. White areas on the left indicate areas covered by clothespin used to attach the papers to the terminals.

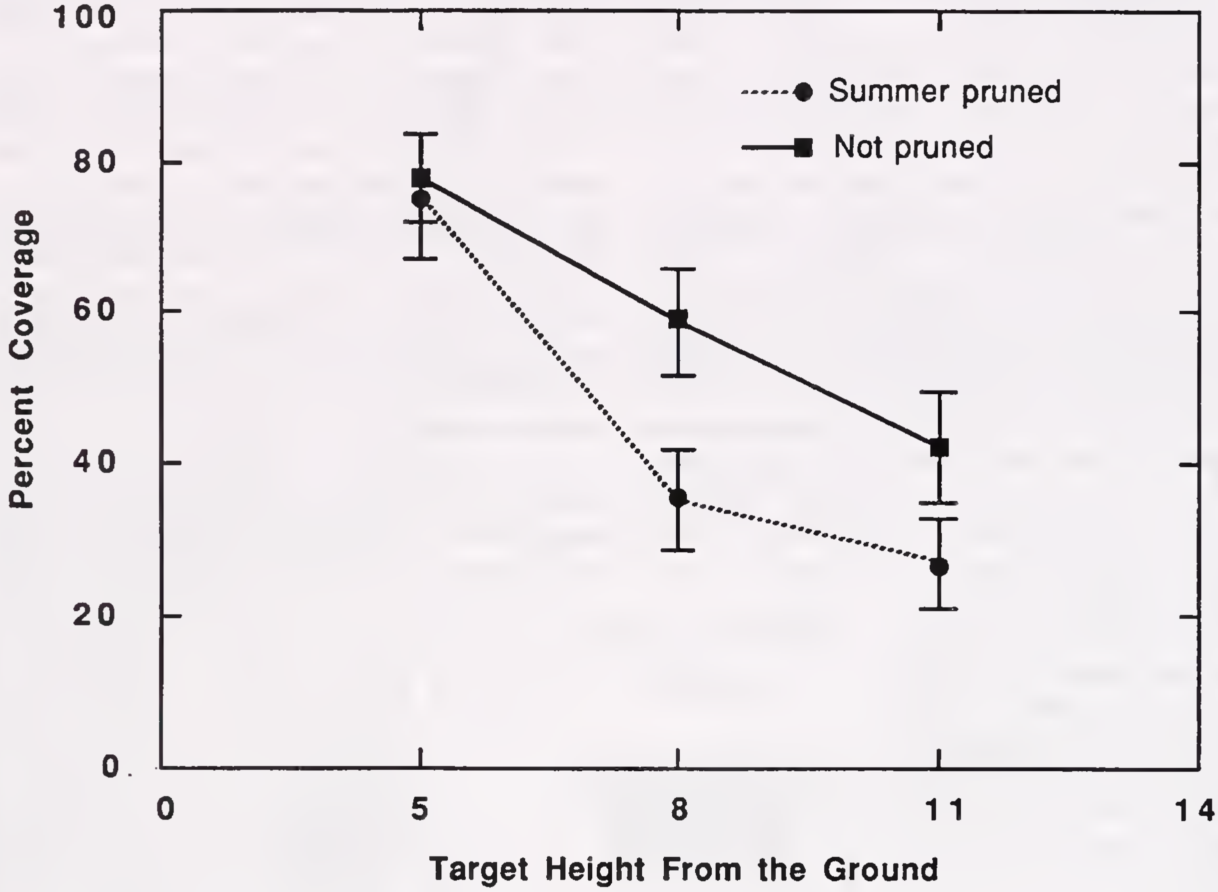

Figure 3. Coverage of targets placed at different heights in canopies of summer-pruned and non-pruned mature McIntosh/M.7 trees. Standard error bars represent the amount of variability at each point.

is significantly less than that in the lower canopy. Summer pruning improved the amount of material deposited in the canopy, and almost all of the improvement came in the middle and upper sections, nearly doubling the area covered by spray. Summer pruning would improve the deposition of any spray material, whether insecticide, miticide, or fungicide. Hence one might expect improved control of many pests in a summer-pruned orchard.

* * * * *

Second-level IPM for Pests in Apple Orchards: Performance According to Type of Cultivar

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Under second-level IPM, orchard management is integrated across all classes of pests: insects, mites, diseases, and weeds. Under the concept of second-level IPM that we have envisioned for Massachusetts apple orchards, trees would receive pesticide sprays against insect, mite, and disease pests only through early or mid-June. Thereafter, non-pesticidal approaches such as cultural, behavioral, and biological controls would be employed as substitutes for pesticides.

Recently [*Fruit Notes* 60(1):1-7], we reported our conclusions on four years of second-level pilot project research in 12 commercial orchards. In that report, we did not present information on possible differences among apple cultivars in effectiveness of second-level practices. Here, we present a summary of three years of data (1992-1994) from six orchard blocks on effects of full second-level IPM practices for each of three prominent cultivars: McIntosh, Cortland, and Delicious.

Methods & Materials

A full description of the pest management methods used in second-level IPM blocks and of the number of pesticide sprays applied in second-level blocks compared with nearby grower-managed first-level IPM blocks is given in *Fruit Notes* [60(1):1-7]. Briefly, up to early June, three to four insecticide sprays, two oil sprays against mites, and four to five fungicide sprays were applied in second-level and first-level blocks alike. Thereafter, in second-level blocks, baited sticky red spheres were used to control apple maggot flies, removal of wild apple trees within 100 yards of the orchard perimeter was used to control codling moth and lesser appleworm, naturally existing beneficial predators and parasites were used to control mites, aphids, leafminers, leafhoppers, and leafrollers, and summer pruning in combination with reduced fungicide use was used to control sooty blotch and flyspeck.

It is the normal practice in biological sciences to state that differences are truly significant if the odds of those differences occurring by chance are less than one in twenty. This procedure serves us well when studying practices which have the potential to improve crop yield or crop quality. However, in the case of second-level IPM, we are not attempting to improve crop yield and quality but are attempting to maintain them. Because second-level IPM utilizes alternative practices with which we have had minimum experience (not decades of experience), we should be conservative when judging its outcome in comparison with first-level IPM practices. Hence, for the purposes of this ar-

ticle we have chosen to take a more conservative approach than the normal statistical practice, in that we consider differences to be truly significant if the odds of them occurring by chance are less than one in eight. In this way we are more likely to identify differences between first- and second-level practices, and be alerted to possible negative consequences.

Results

For McIntosh, no fruit-damaging pest caused significantly greater injury in second-level than first-level blocks. Among foliar pests, only potato leafhoppers were significantly more abundant in second-level blocks (Tables 1 and 2).

For Cortland, lesser appleworm, leafrollers, white apple leafhoppers, rose leafhoppers, and potato leafhoppers caused significantly greater injury or were significantly more abundant in second-level than first-level blocks (Tables 1 and 2).

For Delicious, apple maggot, codling moth, leafrollers, and flyspeck caused significantly greater injury and white apple leafhoppers, rose leafhoppers and potato leafhoppers were significantly more abundant in second-level than first-level blocks (Tables 1 and 2).

Conclusions

We conclude that for McIntosh, second-level IPM practices achieve a level of fruit and foliar pest control comparable to that achieved by first-level IPM practices. The lone exception was potato leafhoppers, whose adults annually fly from sites of origin several hundred kilometers to the south or west and invade orchards in late June and July, well after residual activity of the last spray against plum curculio has worn off. We conclude that for Cortland, current second-level IPM practices are short of providing needed levels of control of lesser

Table 1. Percent fruit injured by pests in samples taken at harvest in second-level and first-level IPM blocks. Data are combined for 1992, 1993, and 1994*.

Cultivar	Type of Block	AMF	CM	LAW	LR	SB	FS
McIntosh	Second-level	0.7a	0.1a	0.2a	0.7a	0.9a	3.3a
	First-level	1.0a	0.1a	0.1a	0.3a	0.0a	1.7a
Cortland	Second-level	2.0a	0.1a	4.8a	1.2a	0.5a	14.0a
	First-level	1.3a	0.3a	0.7b	0.3b	0.0a	8.4a
Delicious	Second-level	2.5a	0.3a	0.1a	1.0a	2.2a	10.7a
	First-level	0.3b	0.0b	0.0a	0.5b	0.2a	4.0b

*Means in each couplet for each cultivar followed by a different letter are significantly different at odds of 7:1. Two-hundred fruit of each cultivar (10 from each of 20 trees) in each type of block were sampled each year at harvest. Number of blocks of each type containing each cultivar: McIntosh (6 second-level, 6 first-level); Cortland (3 second-level, 2 first-level); Delicious (4 second-level, 3 first-level). AMF=apple maggot; CM=codling moth; LAW=lesser appleworm; LR=leafrollers; SB=sooty blotch; FS=flyspeck.

Table 2. Average peak population levels of foliar pests in second-level and first-level IPM blocks. Data are combined for 1992, 1993, and 1994*.

Cultivar	Type of block	ERM	TSM	AA	WAA	LM	WALH	RLH	PLH
McIntosh	Second-level	40a	4a	58a	17a	26a	14a	6a	18a
	First-level	39a	6a	56a	9a	17a	13a	2a	12b
Cortland	Second-level	45a	4a	55a	0a	38a	12a	13a	18a
	First-level	44a	16a	52a	0a	22a	1b	1b	3b
Delicious	Second-level	52a	1a	76a	3a	40a	28a	4a	21a
	First-level	35a	0a	81a	6a	45a	6b	0b	5b

*Means in each couplet for each cultivar followed by a different letter are significantly different at odds of 7:1. Data represent the average peak percent leaves (for ERM, TSM, LM, WALH, RLH, PLH) or watersprouts (for AA, WAA) infested in 200 leaves or watersprouts (10 from each of 20 trees) sampled at bi-weekly intervals from early June through late August in each type of block each year. Number of blocks containing each cultivar are given in footnote of Table 1. ERM=European red mites; TSM=two-spotted mites; AA=apple and spirea aphids; WAA=woolly apple aphids; LM=leafminers; WALH=white apple leafhoppers; RLH=rose leafhoppers; PLH=potato leafhoppers.

appleworm, leafrollers, flyspeck, and leafhoppers. For Delicious, pests not adequately controlled under current second-level practices include apple maggot, codling moth, leafrollers, flyspeck, and leafhoppers. It may or may not be coincidence that pest problems under second-level IPM were least for the earliest-ripening cultivar (McIntosh), intermediate for the middle-ripening cultivar (Cortland), and greatest for the latest-ripening cultivar (Delicious). We intend to conduct further research to determine whether it is fruit-ripening time per se or some peculiar chemical or physical property of each cultivar that accounts for these apparent differences.

At present, we can recommend with high confidence the use of second-level IPM practices for McIntosh but withhold recommendation at present of their use for Cortland and Delicious pending further investigation.

Acknowledgments

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Preharvest Strategies to Reduce Postharvest Pear Decay

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Decay continues to be one of the most serious challenges facing the pome fruit industry. It is apparent that both the condition of the fruit delivered to the packinghouse and the quality of care and treatment in postharvest handling affect the risk of decay developing during storage. Decay control begins in the orchard. Many decay control practices can be performed throughout the growing season and are extremely important if the grower is to obtain a good packout and storage quality. Results of research on a multifaceted approach to pear decay control indicate that postharvest decay is affected at every step of the production process from orchard fertilizer application to storage atmosphere. The following discussion contains practical information that growers can use to help control decay.

Most fruit infections are caused by spores of pathogenic fungi. All decay-causing fungi survive and multiply in the orchard and are found in soil (*Botrytis cinerea* which causes gray mold, *Mucor piriformis* which causes Mucor rot, *Phialophora malorum* which causes side rot, and several *Penicillium* species which cause Blue Mold) or on the tree (*Pezicula malicorticis* which causes bull's-eye rot). Many factors, including soil temperature, moisture, and nutrient availability, affect fungal populations. Most fungal spores are in the top inch of soil or debris in the orchard. These spores are extremely small (about 1/2500 of an inch) and are spread to the surface of fruit and to picking bins in and/or by rain and irrigation water, dirt and debris, and wind.

Little can be done by growers to alter soil moisture or temperature in a way that will reduce decay. However, orchard sanitation is a key in decay control. Fruit left on the orchard floor after harvest serves as a source of nutrition for fungi. Populations of fungi that cause decay are much greater in orchards that have half a dozen pears on the ground under each tree than in orchards that have only an occasional fruit under the trees. The grower should remember that fruit on the ground does not get sold and only feeds fungi that will rot more of their fruit in storage. Thus, careful supervision of the picking crew is important to minimize the amount of dropped as well as punctured fruit.

Several orchard conditions that affect postharvest performance have been identified. Fruit with high nitrogen (N) content is more susceptible to decay (as well as to some other fruit disorders) than fruit with lower nitrogen content. We have found that in pear trees which need fertilizer, N applications approximately one month before harvest minimize the amount of fertilizer N in the fruit while providing adequate nutrition for tree growth and the following year's flower buds. Applications of fertilizer around bloom time resulted in relatively high levels of fruit N at harvest. Fruit N may also be lowered by reducing overall N availability to the tree, reducing tree vigor, and promoting dense and heavy cropping.

Fruit high in calcium presents a lower risk

of decay than low calcium fruit. Calcium chloride sprays during the growing season are effective in increasing fruit calcium. Fruit calcium also may be enhanced by reduction of tree vigor and promotion of dense and heavycropping.

For several types of postharvest decay, the maturity of the fruit at the moment of harvest has a critical effect on decay risk. Earlier harvest, within the range of acceptable maturity, reduces decay risk. Earlier harvested fruit is usually less prone to bruising during harvest, and bruising may increase susceptibility to rot during storage.

Most postharvest rots begin with infection by a fungus through a small puncture in the skin of the fruit. Punctures can happen on the tree, during harvest, in transport, or during packing. In a study of fruit punctures in field bins of Bosc pears in the Medford district in 1994, fruit harvested by workers paid by the hour had significantly fewer punctures than fruit harvested by workers paid piecework.

In our research, several orchard and storage factors have been combined into an integrated program. Low fruit N, high fruit calcium, early harvest, and CA storage have all reduced decay by several postharvest pathogens. When these treatments are combined, their benefits add up to make a significant impact on decay. Experiments have also shown the value of integrating biological control and thiabendazole (TBZ) fungicide treatments with the orchard and storage factors described above. This may be implemented when the biocontrol agents we have tested experimentally become products labeled for use.

One of the expected benefits of an integrated approach is stability. Since the factors in an integrated program are independent of one another, each is unaffected by the performance of the other factors. As additional techniques are developed or new fungicides or biocontrol agents become available, they can be integrated as new elements of this program.

Growers also can work together with packinghouse personnel in the area of bin sanitation. It is the responsibility of the packinghouse to provide clean bins, but it is the responsibility of the grower to keep them clean before and during harvest and to send full bins back to the packinghouse as free as possible of dirt and debris. In both Australia and South Africa, fruit growers harvest into bins placed on trailers. The South Africans often connect several trailers into a train which is pulled between the rows and "loaded" by pickers from both sides. The main point is that bins should be kept as clean as possible. Bins pushed through the dirt or mud with a fork lift will carry tremendous numbers of spores into the packinghouse, only to be washed into the drench or dump water and deposited on all fruit passing through the system.

In addition to the above decay reduction measures, growers can reduce decay by application of a preharvest fungicide. Several studies have been done on the effectiveness of preharvest ziram and show an average reduction in decay of about 25-50% with a single application. In some years, bull's-eye rot has been reduced by over 80%. Preharvest ziram application also has given over 90% control of another decay, Coprinus rot (*Coprinus psychromorbidus*), which appears similar to bull's-eye rot and has been found on apples and pears from Hood River to British Columbia. Because ziram has good retention properties, an application made two to four weeks before harvest will still give a good residue at harvest. Control of decay with aerial applications has been better than when no fungicide is used but is not as effective as a ground spray because of poorer coverage.

An integrated approach is essential for good control of decay. Both the grower and the packinghouse personnel must use all the tools discussed above to the best of their ability if healthy, high quality fruit are to be shipped to market.

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Practices to Reduce Postharvest Pear Diseases

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The fruit grower plays a critical role in determining the quality of fruit delivered to the consumer. This is true even in the area of diseases that show up in the packinghouse. Growers must begin control procedures in the orchard for fruit diseases which appear long after harvest. Preventing wounds, which are the sites for disease infection, is a critical responsibility of the grower.

Postharvest diseases cost everyone money -- disease reduction in the orchard is less costly than cullage after storage. Cullage means slow movement of fruit in the packinghouse, an expensive job of repacking, or even rejection of lots in the marketplace. We will review preharvest factors affecting postharvest decays of pears and discuss postharvest control within the storage and packinghouse.

Information About the Diseases

The major postharvest diseases of pears are caused by fungi. Especially important in the Pacific Northwest are the diseases Gray Mold (*Botrytis cinerea*), Blue Mold (*Penicillium expansum*), Coprinus rot (*Coprinus* spp.), Mucor rot (*Mucor piriformis*), side rot (*Phialophora malorum*), and bull's-eye rot (*Pezicula malicorticis*). In most cases orchard sanitation and sprays will significantly reduce the amount of diseased fruit in the warehouse.

*Gray Mold (*Botrytis cinerea*)*

Botrytis rot is a common decay of Anjou pears. This fungus enters through punctures and wounds. Minimize injury to fruit to reduce the amount of decay from this fungus. However, *Botrytis* also enters through the stem ends of Anjou pears, since the tissue at the tip of the stem remains alive even after the fruit has been picked. Researchers at the Mid-Columbia Research Station hoped that *Botrytis* infection could be reduced by drying stem tissue. Pears were kept up to two weeks at room temperature or four months in cold storage. Unfortunately, the stems did not heal. Stem ends apparently remain a site for infection even long into the storage period. *Botrytis* spores on the stem end can grow down the stem and into the fruit flesh, causing decay and eventually *Botrytis* nest-rot.

The source of *Botrytis* spores is in the orchard. Fungus grows and sporulates abundantly on dead and dying plant material found in orchard cover crops, especially during cool,

moist weather. *Botrytis* spores are formed in clusters and can become airborne. Millions of very small spores can form in a short time. In addition to causing stem enddecay and the infection arising in wounds, *Botrytis* rot has the ability to move from fruit to fruit during the storage season. It can spread over time from infected fruit to surrounding healthy fruit and form a cluster or nest of decay. Hence, this disease has been called nest-
rot.

Blue Mold (Penicillium expansum)

Blue Mold caused by *Penicillium expansum* is a common and destructive rot found on fruits in storage and at the market. Blue Mold spores, like Gray Mold, can be airborne in tremendous numbers.

Stem and neck rot develops from stem infections in fleshy stemmed varieties such as Anjou and Comice. Losses from this disease have increased since use of polyethylene box liners has extended the storage season for pears. The amount of decay that develops on a single fruit depends upon the length of the storage period. It may involve only the stem, the stem and a small area at its base, or the entire upper half of the fruit. High humidity within the polyethylene box liner favors the development of the white to bluish-green fungal mass of spores on the surface of infected tissue.

Pinhole rot occurs mainly on Winter Nelis, a pear variety with large, prominent lenticels. It first appears as numerous minute spots of decay scattered over the surface of the fruit; infection apparently occurs at the lenticel. As the disease progresses, the spots increase in size and finally coalesce, and the entire fruit decomposes.

Blue Mold is generally considered a wound parasite, but it can penetrate through lenticels, particularly those near bruises. Late in the storage season when fruit has become weakened by ripening and aging, most varieties are susceptible to lenticel infection by Blue Mold. This type of infection may result when rotted pears are handled carelessly during repacking. Environmental conditions such as moisture, ventilation and temperature directly influence the development of decay. The atmospheric moisture necessary to prevent pears from shriveling is sufficient for Blue Mold development. Lack of ventilation due to tight packing and lack of air space in storage increases the moisture around the fruit and slows the rate of cooling, making conditions favorable for fungus development.

Fungus diseases develop more rapidly at temperatures higher than the usual storage temperature for pears. Pears that are delayed going into storage, cooled slowly in storage, stored till late in the season, or held at warm temperatures after removal from storage are particularly subject to infection. Disease is not necessarily prevented or arrested even at 30° to 32°F. Rotten spots continue to enlarge, and even new infections can be initiated at these temperatures. Decay proceeds slowly in the early part of the storage season when fruit is firm and somewhat resistant, but during long periods of storage it can cause serious losses.

Coprinus Rot

Another fungal disease is *Coprinus* rot, which is often mistaken for bull's-eye rot. *Coprinus* rot has appeared in both Hood River and Wenatchee. This low temperature organism (mushroom fungus) will nest and spread like Gray Mold. Spores come from a mushroom in the orchard and appear to infect fruit during the last month before harvest. One major difference between *Coprinus* rot and bull's-eye rot is the presence, in cold storage, of a cobweb-like, white fungal growth on the fruit surface in *Coprinus* rot.

Mucor Rot

Mucor is a soil-borne fungus that grows well even during the winter. It is found in varying amounts from orchard to orchard and varies in quantity depending upon the time of year. For example, immediately after harvest the spore count in orchard soil increases. The *Mucor* fungus is found in debris and litter on the soil surface and most occur in the top two inches of soil.

Some orchards have high levels of *Mucor* which is related to high soil moisture and an abundance of fruit on the ground. When the bottoms of bins are in contact with contaminated soil, a large number of *Mucor* spores can be brought into the packinghouse in and on the bins.

Pears which had fallen on the ground were examined for evidence of fungal spores. During harvest most of the fruit on the ground had begun to rot with Gray Mold. One month after harvest most of the fruit was being decayed by *Mucor*. One method of reducing the number of spores on the orchard floor would be to pick up any of the early maturing fruits (e.g., Bartletts) lying on the ground. These fruits provide nutrients for the buildup of high levels of fungal spores, which may contaminate and infect later harvested Anjou or Bosc pears. Rodents such as mice and squirrels, as well as insects and rain, are factors in spreading decay organisms throughout the orchard.

Mucor spores are not easily airborne. This is in direct contrast to *Botrytis* and *Penicillium* spores. To reduce the amount of spores going into the packinghouse, growers can put a layer of gravel or wood chips on the soil surface to insulate the bottom of the bins in the loading area. Thoroughly rinsing the bottom of the bins with water to remove contaminated soil before the bins go to the packinghouse also would reduce the number of spores.

Side Rot

Side rot has been a problem in the Medford, Oregon pear-growing district for the past several years. Though the primary causal fungus, *Phialophora*, has been found on decaying pears in Washington, it is not currently an economic problem there or in the Hood River district. Side rot has been found on Anjou and Comice pears, but the most serious losses have occurred on Bosc. It is a problem of long-term storage; infections become visible in late Dec. or Jan., and incidence of decay increases as the storage season continues.

Research at the Southern Oregon Experiment Station has shown that side rot lesions can be caused by two fungi, *Phialophora malorum* and *Cladosporium herbarum*. Typically dark brown, dime-size decay lesions separate cleanly from adjacent healthy flesh. The color and texture of the decayed tissue vary with the amount of drying due to skin breakage. Both of these fungi are relatively slow-growing, weak pathogens which apparently must wait for fruit to weaken through age before infecting. *Cladosporium* is sensitive to thiabendazole (TBZ), while *Phialophora* is not. Most side rot in fruit treated postharvest with thiabendazole is caused by *Phialophora*.

Table 1. Decay in attached Anjou pear fruits inoculated monthly during the growing season in 1980 and 1981.

Week of inoculation before harvest	Percent decay* caused by			
	Botrytis cinerea	*Mucor piriformis*	*Penicillium expansum*	*Pezicula malicorticis*
0**	82	18	69	100
6	14	0	0	99
9	2	0	2	100
15	0	0	0	74
19	0	0	0	69

*Decay is the total from evaluations conducted monthly during the growing season, during storage, and after a one-week ripening period. Each value represents the mean of 50 fruits. Researchers made two needle punctures per fruit through drops of inoculum.

**Fruit were inoculated two days before harvest.

Fruit Susceptibility to Decay

Pathologists at the Mid-Columbia Research Station studied changes in susceptibility of fruit to decay throughout the growing season. In summary, fruit becomes most susceptibleto the fungal decay organisms during the last month before harvest. However, infection by the bull's-eye rot organism can occur any time from petal fall to harvest.

Pears were wounded and inoculated throughout the growing season with the different decay-causing fungi. Fruit was harvested and placed into storage for seven to eight months. The decay was generally less than 10% on fruit sprayed with fungal spores a month or more before harvest (Table 1). Fruit treated with decay organisms during the last few weeks before harvest was seriously decayed during storage. Consequently, growers should time chemical control programs to cover fruit at least two to three weeks before harvest, as it loses its resistance to decay.

Harvest maturity is critical. Studies on Bosc pears have shown dramatically that more decay occurs on later picked fruit. By delaying harvest two weeks after commercial harvest, there was a significant rise in the amount of infection in nonwounded fruit that was sprayed with the fungal suspensions.

Sprays to Control the Diseases

Three factors are of primary importance in designing a fungicide spray program. These factors include 1) when spores of a particular disease organism are present in the greatest quantity, 2) when fruit is most susceptible to infection and decay, and 3) when environmental conditions most favor infection.

Certain postharvest rots occur when infected flower parts are trapped in the calyx end of the fruit soon after bloom, i.e., calyx-end infections by *Botrytis*. A spray of Ziram, Manzate-200, or Dithane M-45 within 10 days of petal fall helps reduce infection. Growers in areas with bull's-eye rot may need a second fungicidal spray if it rains in August. Preharvest sprays of Ziram also help reduce side rot incidence.

Cultural Practices to Reduce Decay

During the winter months, prune trees to eliminate low hanging branches which might set fruit in contact with cover crops or lie on the ground. These fruit can easily come in contact with soil-borne spores and become infected as a result of the high humidity in the microclimate of the cover crop.

During the summer months, it is important to keep weeds and grass under control. Spores can be released from the cover crop, which also provides high humidity for germination. In particular, Gray Mold and other *Botrytis* species grow well on weakened or dead plant material in the orchard. Periods of rainy weather or excessive irrigation promote the growth and sporulation of these fungi, which account for a general increase in the incidence of Gray Mold in wet years. Conversely, too little water may promote dusty conditions, which result in spread of the soil-borne spores of *Mucor, Penicillium,* and *Botrytis*.

At harvest, growers can do a number of things to reduce postharvest decay. Injury to fruit during harvest and packing is probably the most critical factor leading to postharvest decay. Harvesting fruit at the proper maturity is also extremely important. Pears harvested on the immature side will abrade easily on the packingline. Overmature fruit or fruit harvested late in the maturity range has reduced storage life and is more susceptible to postharvest diseases. Fruit is most susceptible to diseases as it approaches maturity.

Proper handling becomes critical in preventing decay and bruising. Pickers should not pick up "grounders" (fallen fruit), since that fruit is likely to be infected as well as ripening prematurely. Volatiles produced by these fruit stimulate the ripening of adjacent fruit and reduce storage life.

Avoid harvesting wet fruit, as it likely will have spores adhering to the surface which may germinate and infect. Allow fruit to dry before harvesting.

Most postharvest rot organisms are soil inhabitants and can be picked up on the skids or sides of bins. Mow the cover crop or use saw-

dust or wood chips under bins rather than allowing them to touch the soil. Do not skid bins on the orchard floor, load the bins roughly, or allow drivers to speed through the orchard. Urge pickers to handle fruit delicately to prevent bruising. Finally, immediately take picked fruit to the packinghouse where it can be cooled rapidly.

Control of Postharvest Disease of Pears in the Packinghouse

Control of postharvest diseases in the packinghouse is based on spore load reduction through sanitation and killing spores with fungicides. Minimize damage to fruit by thorough padding of surfaces and overall maintenance of equipment.

Controlling Spore Load in the Dump Tank

Pear packinghouses use either chlorine or SOPP (sodium ortho-phenylphenate) in the dump tank and flumes. Chlorine can do a very effective job of killing spores in a dump tank if the concentration of chlorine is correct, the amount of dirt in the water is minimized, and all areas of the fruit are penetrated. Chlorine, however, lacks the ability to provide long-term coverage of fruit in storage or on its way to market and cannot penetrate wounds well.

The concentration of spores in a dump tank can be critical in terms of control of fungal diseases in the packinghouse (Table 2). Several organizations are available to monitor the number of spores in a dump tank. If monitoring is used, 100 spores/ml should not provide a problem in a packinghouse; however, spore levels over 300/ml should be avoided.

Table 2. The effect of dirt on the ability of chlorine to kill fungal spores.

Chlorine	% Decay*
0 ppm	100
50 ppm (dirty water)	75
50 ppm (tap water)	0

*Combination of *Mucor*, *Botrytis* and *Penicillium* spores.

The pH of a solution in which chlorine is used will influence the amount of killing that chlorine provides. Flotation salts dramatically raise the pH to the alkaline area in most cases. Operators are warned not to acidify or reduce the pH or chlorine when used with sodium silicate, since the flotation salt solution will form a gel and solidify. Disposal of 3,000 gallons of "Jell-O" can be a problem.

Tests have been run on the fungicidal effects of various flotation salts. Most of the flotation salts have no fungicidal properties, that is, they do not kill fungus spores. However, sodium ligninsulfonate prevents germination of fungal spores when used alone. When it was combined with SOPP in the laboratory tests, no decay spores germinated. Ligninsulfonate has a number of problems which must be considered. First, SOPP measurements are difficult due to the color of the solution. Second, fruit must be thoroughly rinsed following treatment to avoid injury. Operators should be aware that ligninsulfonate and chlorine are not compatible and should not be mixed.

Heat Treatment of Dump Tanks

Heat treatment of pear dump tanks is another method of reducing spore load. Over the past several years we have been experimenting with heat sterilization of the dump tank for those using SOPP in the system. It appears that 130°F for 20 to 25 minutes kills spores in the dump tank.

The procedure is to lay a styrofoam cover over the tank at night after all the fruit is out to turn on the boilers to raise the temperature. In commercial trials it took about 4 hours to bring the tank up to the 130°F level. The boilers then were turned off and the styrofoam was removed. By morning the water was back to 70°F, so the fruit could be run without injury. Water loss

Table 3. Sensitivity of common pear decay pathogens to thiabendazole.

Sensitive	Tolerant
Penicillium (Blue Mold)	*Mucor*
Botrytis (Gray Mold)	*Phialophora* (side rot)
Pezicula (bull's-eye rot)	*Alternaria*
Cladosporium	

due to heating was about 10% and SOPP loss about 25%.

We have done these trials with both silicate and ligninsulfonate solutions. The tank containing ligninsulfonate was reheated once weekly for three to four weeks, during which period of time it was not dumped and spore count remained low.

Thus, this method reduces the number of times during the season that tanks must be emptied. However, organic matter and other debris eventually accumulate in the tanks and the tanks require cleaning.

Heating also will sterilize infected fruit at the bottom of the tank. The calculated cost to clean, empty and refill the tank was about $800, while the cost to heat sterilize the tank was about $200. Good ventilation of the packinghouse during heating is important.

Direct Control of Decay Pathogens

Spores of decay pathogens that survive dump tank SOPP or chlorine treatments or which contaminate the fruit after it leaves the dump tank may be prevented from infecting by application of a fungicide line spray. Commonly, the benzimidazole fungicide thiabendazole (TBZ) is applied but, unfortunately, not all postharvest pathogens are controlled by this fungicide. The following table lists common pear decay pathogens according to their sensitivity to thiabendazole.

Tank mixtures of TBZ + Captan can improve control to a small extent but do not significantly expand the range of protection. However, the use of Captan after harvest on pears sprayed with oil during the summer or wrapped in oil paper can develop blotchy discoloration on the skin.

In recent years concern has been raised about the development of resistance to benomyl in decay pathogens. Resistant strains have been found in all major pear-growing districts. A close examination of this potential problem has been made in the Hood River district, where records show the incidence of resistant strains has been stable for the past several years.

Postharvest Fungicides for Decay Control

Fungicides such as thiabendazole (TBZ) and Captan are of tremendous importance in decay control. The fungicides are often applied in a line spray, after fruit crosses the sorting tables, and often in combination with wax. Frequent use of benomyl or thiabendazole in the orchard has resulted in buildup of resistant strains of *Botrytis* and *Penicillium* in many parts of the world; thus, orchard use of these fungicides should be avoided. Limiting benzimidazole fungicides to packinghouse applications is critical to preserve its effectiveness. Sanitation to prevent increase and spread of resistant strains isalso important. In addition, new fungicides are being evaluated for their potential in controlling postharvest pathogens.

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Fruit Notes

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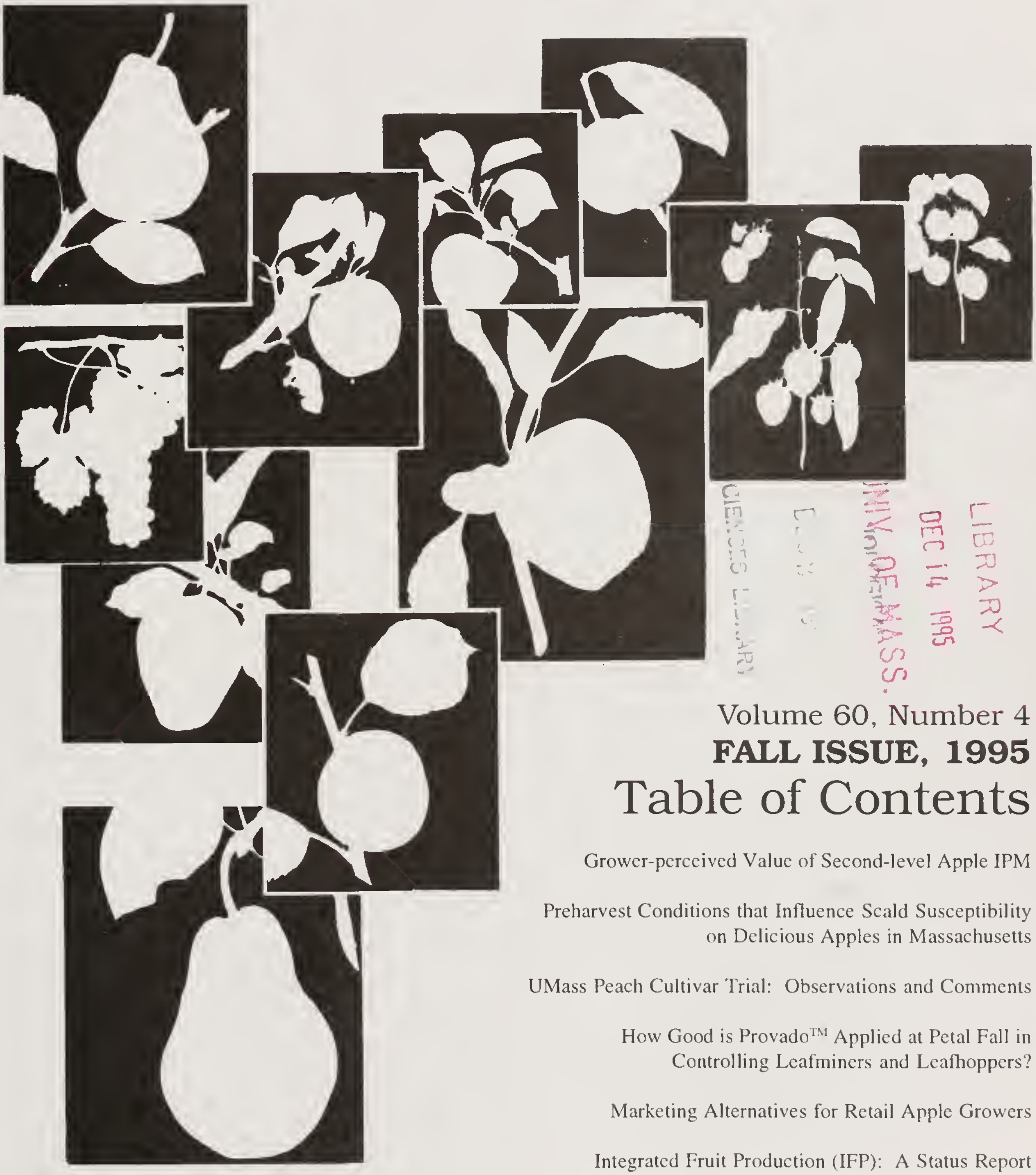

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Grower-perceived Value of Second-level Apple IPM

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At our most recent meeting of the Apple IPM Project Advisory Committee in November of 1994, we asked Committee members to voice their perception of the value of apple IPM to stakeholders. The assembled Committee, comprised of seven growers, two private consultants, two environmental health specialists, and one product market advisor, generally agreed that to date perhaps the greatest value of first-level IPM to growers has been reduction in the amount (and therefore the cost) of pesticide use plus psychological assurance that pests are unlikely to get out of hand before the beginning of an attack has been detected. First-level IPM emphasizes monitoring pests and weather and spraying a selective pesticide based on monitoring information.

The next question put forward to the Committee focused on possible benefits of second-level IPM, which, as presently construed, offers little or no overall reduction in pest-management costs compared with first-level IPM, because several of its practices call for substituting pesticide use and cost with labor use and cost. Second-level IPM calls for substituting behavioral, biological, and cultural control methods for pesticide wherever possible but particularly after mid-June. The Committee put forward several suggestions regarding the potential value of second-level IPM to stakeholders. Inherent in these suggestions was the assumption that second-level IPM controls pests just as well as first-level IPM does.

At three twilight meetings of apple growers in May of 1995 (one each in western, central, and eastern Massachusetts), we conducted a written survey of grower response to the Committee's ten suggested potential values of second-level IPM. We asked that only those who owned or operated an apple orchard reply and that the ten suggested values of second-level IPM be ranked in order of perceived importance. We also asked growers to indicate if they perceived no potential value for second-level IPM on their farms in the foreseeable future.

Results of the survey, presented in Table 1, show that the greatest perceived potential value of second-level IPM lies in creating a positive image with the general public and legislators that apple growers are doing their very best to minimize pesticide use. The second, third, and fourth greatest perceived potential values concern the positive effect of greater buildup of beneficial natural enemies, reduction in pesticide residue on fruit at harvest, and reduction in rate at which pests become resistant to pesticides. The fifth-place perceived value involves educating customers coming to roadside stands that growers are being very environmentally responsible in their pest-management practices.

If the greatest perceived value of second-level IPM is one of building a more positive image of apple-growing practices with the general public and legislators, then apple growers in Massachusetts and we in UMass Extension ought to be thinking of concrete ways to advance image building. One excellent suggestion along this line was made by a respondent to our questionnaire. The suggestion was that growers who sell apples retail from orchard or roadside stands make a display case showing the risk of growing apples without any pesticide together with some of the tools of second-level IPM. Risk is perhaps best demonstrated by displaying a few gnarly infested apples from an unmanaged tree -- the consequences of no pest-management practices whatsoever. The tools might consist of an array consisting of a weather monitor for temperature and leaf wetness used for timing apple scab sprays, white rectangle traps for monitoring plant bugs and sawflies, red rectangle traps for monitoring leafminers, an optivisor for magnifying pests and beneficials, a color close-up picture of an aphid predator or a mite predator, a saw that symbolizes the cutting down of wild apple trees, brambles, and rose bushes within 100 yards of the orchard perimeter to reduce pest immigration, and an odor-baited pesticide-treated red sphere for behaviorally controlling apple maggot flies. Possibly a press

Table 1. Apple grower response to a questionnaire on the potential value of second-level IPM practices for Massachusetts orchardists. A total of 63 of growers responded. Responses are ranked in the order of priority assigned by responders. Numerical values represent the comparative strength of response, with highest values indicating the highest priority.

100	Helps create a positive image with the general public and legislators that apple growers are doing their very best to minimize pesticide use. Could help forestall further legal restrictions against pesticide use in orchards.
91	Buildup of beneficial natural enemies as a consequence of no sprays after mid June.
70	Reduces or eliminates pesticide residue on fruit at harvest.
62	Reduces rate at which pests become resistant to pesticide.
44	Helps educate customers coming to roadside stands that growers are being very environmentally responsible.
33	Promotes worker safety and timely horticultural practices (for example, summer pruning and mowing) by allowing worker entry into orchards at any time from late June to harvest without restraint associated with abiding by mandated re-entry times.
32	Reduces incidence of pesticide drift into border areas, thus helping to allay fears of abutting neighbors or helping to reduce legal liability from potential drift into lakes and streams.
27	Offers a way to preserve future markets for Massachusetts apples (that is, to avoid market restrictions) in the face of increasing competition from "advanced IPM" or "green" apples now being produced in Europe and the West Coast.
4	Reduces potential legal complaints from trespassers.
1	Reduces grower liability to customers in pick-your-own orchards.
0	Has no potential value.

photographer could be called in to photograph the display for distribution in the media.

Engaging in first-level IPM and especially in second-level IPM could go a long way toward building a truly positive image of Massachusetts apple growers in the mind of the general public, and particularly consumers of apples, if the tools of IPM are used as tangible symbols of the IPM process.

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Preharvest Conditions that Influence Scald Susceptibility on Delicious Apples in Massachusetts

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Superficial scald (scald) develops on apples during or following long-term storage at about 32°F. Many postharvest factors affect its development, but the actual scald susceptibility of the fruit is determined by preharvest conditions and the maturity of the fruit at harvest. Studies in England in the 1950s suggested that hot, dry weather during the summer increased susceptibility while cool, dry weather decreased it (Fidler, J. C. 1956. *Food Sci. Abstracts* 28:545-554). Other studies in New Jersey showed that cool temperatures (hours below 50°F) near harvest reduced susceptibility (Merritt, R. H. et al. 1961. *Proc. Amer. Soc. Hort. Sci.* 78:24-34). It also has long been recognized that low-light intensity results in greater susceptibility, as seen by the strong tendency for scald to form on the green side of the fruit. Likewise, it is well known that as fruit become more mature before harvest, scald susceptibility declines.

In 1986, we began sampling apples and examining their scald susceptibility in relation to preharvest conditions. In 1994, we published an article [*Fruit Notes* 59(3):6-10] showing results of experiments which demonstrated that low temperature, sunlight, and ripening all had independent effects on scald susceptibility of Cortland and Delicious apples.

We have obtained large amounts of data on scald development in relation to preharvest conditions from colleagues around the world, to attempt to determine statistically the importance of preharvest temperature, light, and rainfall, along with maturity at harvest (judged by starch-iodine tests), under commercial conditions among years and among many geographical areas. This assessment would give a good indication of the importance of these conditions to growers, might provide the basis for estimating the effects of "unusual" conditions, and hopefully might lead to a reliable scald prediction system at the time of fruit harvest.

Here we report on one small piece of these data: the effects on scald susceptibility of Delicious in Massachusetts. These data were collected over eight years at the University of Massachusetts Horticultural Research Center (HRC), Belchertown using fruit from different blocks and of different strains. Temperature and rainfall records were from the HRC or from records of the Metropolitan District Commission's weather station at the southern end of the Quabbin Reservoir. Light conditions were estimated from the Quabbin records as full sun, partly cloudy, or cloudy.

Starch scores were determined on the day of harvest. A total of 344 lots of fruit were included in

Table 1. Effects of temperature and maturity (starch score) on scald susceptibility of Delicious apples in Massachusetts. Total samples = 273.

Measurement	R^2	Measurement	R^2
Avg temp	0.16		
Avg temp + days below 6°C	0.53	+ Starch score	0.55
Avg temp + days below 8°C	0.50	+ Starch score	0.51
Avg temp + days below 10°C	0.47	+ Starch score	0.51
Avg temp + days below 12°C	0.25	+ Starch score	0.33

Table 2. Effects of rainfall after August 24 and sunshine after September 3 on scald susceptibility of Delicious apples in Massachusetts. Total samples = 273.

R^2 from Table 1[z]	Measurement	R^2	Measurement	R^2
0.55	+ Rain	0.62	+ Sunshine	0.64
0.51	+ Rain	0.55	+ Sunshine	0.56
0.51	+ Rain	0.56	+ Sunshine	0.56
0.33	+ Rain	0.34	+ Sunshine	0.58

[z] The combined effects of average temperature, days below 6, 8, 10, or 12°C, and maturity (starch score).

this evaluation, with numbers of harvests and samples per harvest varying among years.

An important point illustrated in our results is that individual factors are correlated highly with each other, i.e., are interwoven. For example, changes in scald susceptibility associated with variations in average temperature from year to year are correlated highly with changes associated with days below 50°F, days above 86°F, rainfall, and sunshine. Therefore, if we determine just the effect of average temperature, the value obtained will include some of the effects of all the other variables, which means that our results will exaggerate the effects of average temperature. Conversely, if we determine the effects of average temperature and thenthe effects of rainfall, the results may understate the actual effects of both variables since some of the affect of each is taken out through its correlations with the other. Therefore, the statistical approach cannot actually quantify the effects of variables, it can only tell you how much variation in scald susceptibility can be accounted for by a series of measurements.

Overall, scald susceptibility among samples varied from 0% to 100%, averaging 35% of fruit in a harvest developing scald after 20 to 25 weeks in 32°F air plus seven days at 70°F. Some years had greater scald susceptibility than others, and of course, scald decreased with later harvest in a year.

Table 1 shows the overall effects of low temperature on scald susceptibility of Massachusetts Delicious apples. "R^2" values can be interpreted as the proportion of the scald variability among samples that could be accounted for by a given series of measurements. Average temperature after August 1 among samples accounted for 16% ($R^2 = 0.16$) of scald variation, with lower temperatures decreasing scald. When we then took into account the number of days from August 1 to harvest in which the temperature fell to 6°C (43°F), we accounted for an additional 37% of scald variability, bringing the total to 53% ($R^2 = 0.53$). If we made the temperature cut-off 8°C (46°F) or 10°C (50°F) we accounted for slightly less of the variability, but if we made the cut-off at 12°C (54°F) we accounted for very little variability beyond that picked up by average temperature.

What this means is that not only does low temperature reduce scald susceptibility, but also that specific low temperature events (days when it dipped to 6°C, 8°C, or 10°C) had extra benefit in making the fruit less scald susceptible. In the past we have measured low temperature as "hours below 50°F" but in our analyses here we found that just counting days on which this happened gave better results. The results in Table 1 show that it does not make a great deal of difference whether the cut-off is 43, 46, or 50°F.

When we measured fruit maturity at harvest using a starch-iodine test, we accounted for very little extra scald susceptibility (Table 1). This does not mean that maturity is unimportant, because we know it is. What it does mean is that in Massachusetts, the effect of maturity is very closely linked to low temperature events, so that when you measure temperature effects, you are also including the effects of maturity. Apparently, in Massachusetts the typical decline in temperature during the Fall coincides so closely with Delicious maturation that you cannot statistically separate the effects of fruit maturity (starch score) on scald susceptibility.

In Table 2, the effects of rainfall after August 24 and sunshine after September 3 are added to those shown in Table 1. These dates were chosen

arbitrarily because they gave the highest R^2 values for rainfall and sunshine data, i.e., best represented the effects of these conditions. Rainfall generally increased the R^2 values significantly, showing that more rainfall produced less scald. (It is usually cooler when it is raining, but the effects on any associated low temperatures have already been removed in the equations.) Sunshine had small effects on scald susceptibility, with sunnier days in early Fall decreasing scald.

These results show that low temperature (especially below 50°F), adequate rainfall, and sunny days all reduce scald susceptibility of Delicious apples grown in Massachusetts. Such years should produce fruit with relatively low scald susceptibility; whereas warm, dry years will produce fruit with more susceptibility, especially if it is cloudy (or if trees have a thick canopy of leaves). Collectively, we have accounted for about two-thirds of scald variation with these measurements.

In follow-up articles we shall compare the relationships in Massachusetts with those inother parts of the world, consider some cultivars, other than Delicious, and examine the prospects for predicting scald susceptibility from measurements such as these.

* * * * *

UMass Peach Cultivar Trial: Observations and Comments

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In the late 1980s, it became apparent that tree fruit growers who marketed their crops primarily through retail channels could benefit from increasing their product mix. Adding or expanding a peach planting, planting newer, better peach cultivars, or adding nectarines or white-fleshed peaches each could serve to increase cash flow, attract customers earlier in the growing season, and provide an excellent alternative to over production of less popular apple cultivars.

Very little research on peaches was undertaken in Massachusetts during the 1980s. Growers relied on information provided by other areas - such as New Jersey, Michigan, and the Southern states. Cultivars that were recommended in those areas often did not adapt well to our growing conditions.

Therefore, in 1990, funded by a grant from the Massachusetts Fruit Growers' Association, I planted a trial block of 15 cultivars (13 yellow-fleshed peaches, one white-fleshed peach, and four nectarines) at the University of Massachusetts Horticultural Research Center in Belchertown. Trees were planted, in groups of four per cultivar, at 10 by 20 ft. spacings.

The primary goal of this planting was to make a "quick & dirty" evaluation of hardiness, quality of fruit, and productivity for each cultivar. In 1993, seven additional cultivars were added (four yellow-fleshed and three white-fleshed peaches); however, tree death has force abandonment of this planting. In 1994, two additional nectarines and two white-fleshed peach cultivars were planted. Additional cultivars will be planted in the spring of 1996, including those planted in 1993.

Cultivar choices were based on information provided by J. Frecon, Rutgers University, NJ, and from Adams Co., Stark Brothers, and Hilltop Nurseries. All trees were winter and summer pruned, fertilized annually, and treated with insecticides, fungicides, and herbicides according to conditions at the Horticultural Research Center.

Following are observations and comments on each cultivar in this trial that has been evaluated to date. Listing of cultivars included in new plantings also is included.

Yellow-fleshed Peaches

Jerseydawn	Ripens early to mid-August. Good size, fewer split pits than other early cvs., flavor variable from year to year - good, but not exceptional. Less than 30% bud survival, winter '93-'94.
Redhaven	The most widely planted cv. in MA orchards. Ripens mid-August. First fruited in 1991. Good size, flavor and skin color. Less than 10% bud survival winter '93-'94.
Salem$^{TM(A)}$	Fruited first in 1991 (two boxes from 4 trees)! Size is medium-large, good quality. Flavor in 1995 was excellent. Flesh is melting, juicy and firm. Very few flower buds survived the winter of '93-'94.
Flavorcrest	First fruited in 1992. Ripens mid- late August. Size is good; flavor is good - survived the winter of '93-'94 well - 75% bloom above 4 ft.; 25% bloom 4 ft. to ground level.
New Haven	First fruited in 1992. Ripens mid-August. Size is good, color is good, fruit flavor is excellent - flesh is firm but melting. After the winter of '93-'94, 75% bud survival top of trees, 10% at 4 ft. and below.
Madison	First fruited in 1992. Ripens early September (should be available Labor Day). Trees are very productive, fruit has good size, flesh is juicy, melting, and has excellent peach

flavor. Madison was the hardiest cv. during the winter of '93-'94 with 85% bud survival.

Bounty — First fruited in 1992. Ripens end of August - early September. Its size is its best quality. Fruits are very large; flavor is good. Trees are productive. Bounty had less than 10% bud survival after the winter of '93-'94.

Ernie's Choice — First fruited in 1991. Ripens mid-August. Size is good, fruit quality is disappointing - little flavor. Only a few buds survived the winter of '93-'94.

Harrow Beauty — First fruited in 1992. Ripens mid-August. Size is good, flesh is firm and melting. Flavor is good. Bud survival was less than 10% after the winter of '93-'94.

Jim Dandee™(H) — First fruited in 1991. Ripens mid-late August. Fruit is huge; color is good; flesh is firm, melting, juicy, and has excellent flavor; freestone. Trees are productive. Bud survival was low - 10% after winter of '93-'94.

Harcrest — First fruited in 1992. Ripens late August. Fruit size is good; fruit quality is excellent - melting, sweet flesh with strong peach flavor, freestone. Trees are productive. Bud survival was good - 60% above 4 ft. and 10% below 4 ft. after the winter of '93-'94.

Fayette — First fruited in 1991. Ripens early-mid September. Size is good; color is good; fruit is good to excellent. May be a little late ripening for many growers who are into apple harvest. However, this is a very good late-season peach. Bud survival was poor - less than 10% after the winter of '93-'94.

Encore™(S) — First fruited in 1992. Ripens mid-late September. (I harvested the last few peaches 9/28/95.) Fruit size is good with good color. Encore has a recessed stem end which makes harvesting more difficult. Fruit is firm, melting, good flavor, with a somewhat astringent aftertaste. Very late for McIntosh growers.

White-fleshed Peaches

Summer Pearl™(S) — First fruited in 1995. Fruit was of good size, firm fleshed, melting, juicy and excellent flavor. (A popular cv at the Research Center!) Bud survival was low, about 10% after the winter of '93-'94.

Nectarines

Earliscarlet — First fruited in 1991. Ripens in early-mid August. Fruit size is excellent, color also is very good, great tasting nectarine. Productive. Approximately 50% bud survival after the winter of '93-'94.

Fantasia — First fruited in 1992. Ripens in mid September. Size and color are outstanding. Flesh is firm, melting with excellent flavor. A cultivarthat is grown extensively on the West coast that also does very well here. Very productive trees. Approximately 50% bud survival after the winter of '93-'94.

Redgold — First fruited in 1992. Ripens early-mid September. Fruit size is good, color is variable, flavor is variable - in 1994 flavor was mild, in 1995 flavor was very good. Not as productive as Earliscarlet. Approximately 40% bud survival after '93-'94 winter.

Summer Beaut™(A1) — Fruit fruited in 1991. Ripens

mid-August. Fruits are medium to large, color is variable. Flavor is good. About 40% bud survival after the winter of '93-'94.

1993 Planting

Yellow-fleshed peaches included Earlired, Beekman, John Boy[TM(A)], and Sentry. White-fleshed peaches included Mountain's Rose, Lady Nancy[TM(A)], and Red Rose

1994 Planting

White-fleshed peaches included White Lady[TM(A)] and Sugar Lady[TM(A)]. Nectarines included Easternglo[TM(A2)] and Sunglo.

In summary, there are several cultivars in this trial that are appropriate choices for Massachusetts growers. Flavorcrest, Newhaven, Madison, and Harcrest should all produce at least a partial crop after a cold winter (temperatures down to -20° F.) and should be suitable for colder sites. Based on fruit quality, Salem, New Haven, Madison, Jim Dandee, Harcrest, and Fayette, were all good to excellent. Summer Pearl is a very good white-fleshed peach, but compared to yellow-fleshed cultivars, it was much slower to bear a crop. (It will be interesting to see how the newer white peach cultivars compare - they are all described as being firmer and easier to handle.) The nectarines were hardier than the peaches, were very productive, and generally had good quality. Earliscarlet and Fantasia are both exceptional and can easily compete with nectarines from the West Coast. Careful attention to disease management can reduce greatly the incidence of brown rot on nectarines, and thinning practices will help ensure competitive size at harvest.

TM(A) - Plant patented cultivar, Adams Co. Nursery, Inc. Aspers, PA.
TM(S) - Plant patented cultivar, Stark Bro's Nurseries and Orchards Co., Louisiana, MO.
TM(H) - Plant patented cultivar, Hilltop Nurseries (Newark Nurseries), Hartford, MI.
TM(A1) - Plant patented cultivar, Burchell Nursery, Inc. Modesto, CA.
TM(A2) - Plant patented cultivar, Dave Wilson Nurseries, Hickman, CA.

* * * * *

How Good is Provado™ Applied at Petal Fall in Controlling Leafminers and Leafhoppers?

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In 1995, a new insecticide called Provado™ (common name imidacloprid) received a label for use in controlling leafminers, leafhoppers, and aphids on apple trees. Researchers in New York have tested Provado for several years in experimental apple tree plots and have concluded that it has excellent potential for controlling these three foliar pests of apple. Fortunately, it appears to have relatively little negative effect on beneficial predators of mites and aphids.

Prior to 1995, we in Massachusetts have had no experience with Provado as an orchard insecticide. Here, we provide data on the effects of a single petal-fall application of Provado against leafminers, white apple leafhoppers, and rose leafhoppers. We did not design tests specifically to evaluate effects of Provado against these pests. Rather, the opportunity to gather meaningful data arose during the course of experiments aimed at studying immigration patterns of rose leafhoppers into commercial orchards.

Materials & Methods

In Orchard A, four plots of semi-dwarf trees received a grower-applied spray of Provado at petal fall at a rate of 2 ounces per 100 gallons (6 ounces per acre). Four nearby similar plots received no Provado. No other leafminer-controlling pesticide was applied to any of the plots. On July 31, we examined ten randomly selected leaves on each of the five trees in each plot for evidence of leafminer mines.

In Orchards A, B, and C, eleven one-half-acre blocks of semi-dwarf trees received a grower-applied spray of Provado at petal fall at the above rate. In Orchards D, E, and F, eight similar blocks received no Provado at petal fall. None of these 19 blocks received any other insecticide aimed at controlling leafminers. All were treated with an application of Sevin as a thinning spray during the last week of May. None received Sevin thereafter and none received Thiodan or any other insecticide directed against leafhoppers or aphids. During the first week of June, we hung four yellow sticky traps in each block to monitor numbers of rose leafhopper adults immigrating from patches of rose bushes within 50 yards of the block perimeter. We counted captured adults during the fourth week of June. During the third week of July, we counted the number of rose leafhopper nymphs and white apple leafhopper nymphs on ten randomly selected leaves on each of five trees per block. We did the same for leafminer mines during the first week of August.

Results

Significantly more (22 times more) combined first- and second-generation leafminer mines were found in untreated than in Provado-treated plots of Orchard A (Table 1). Similarly, significantly more (27 times more) first- and second-generation leafminer mines were found in untreated than in Provado-treated blocks in Orchards A-F (Table 2).

Almost identical numbers of rose leafhopper

Table 1. Effect of a petal fall application of Provado on apple blotch leafminer larvae in Orchard A.

Treatment	Mean number combined first- and second-generation mines per leaf*
Provado	0.05b
No Provado	1.09a

* Means followed by a different letter are significantly different at odds of 19:1.

Table 2. Effect of a petal-fall application of Provado on leafminer mines and leafhopper adults and nymphs in Orchards A-F.

Orchard	Treatment	Combined first- and second-generation leafminer mines per leaf	Rose leafhopper adults per trap	Rose leafhopper nymphs per leaf	White apple leafhopper nymphs per leaf
A-C	Provado	0.02b	22.9a	0.02b	0.01b
D-F	No Provado	0.53a	24.1a	0.45a	0.38a

*Means in each column followed by a different letter are significantly different at odds of 19:1.

adults were trapped in blocks of Orchards A-F that received Provado as in blocks that did not, possibly suggesting no negative effect of Provado against rose leafhopper adults (Table 2). However, significantly fewer (only about 1/20 as many) rose leafhopper nymphs and significantly fewer (only about 1/40 as many) white apple leafhopper nymphs were found in Provado-treated than in untreated blocks (Table 2).

Conclusions

Even though the data reported here were gathered from commercial-orchard blocks whose intended experimental use was not for the express purpose of measuring effects of Provado on insect pests, the data nonetheless provide compelling evidence that a petal-fall treatment of Provado can provide excellent control of leafminers as well as nymphs of both white apple leafhoppers and rose leafhoppers. The excellent control of rose leafhopper nymphs surprised us, because we anticipated that the effects of application of Provado at petal fall during the third or fourth week of May would not extend until mid- or late June to provide control of rose leafhopper eggs or nymphs, which did not appear until mid- or late-June. The effect of Provado could well have been on the eggs or nymphs and not on the adults of rose leafhopper because Provado did not reduce rose leafhopper adult abundance as measured by trap captures. We conclude from these 1995 data gathered in commercial orchard blocks that a single application of Provado at petal fall has excellent potential for providing season-long control of substantial-to-high populations of leafminers, white apple leafhoppers, and rose leafhoppers while (according to New York findings) posing comparatively little threat to beneficial predators.

Acknowledgments

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Marketing Alternatives for Retail Apple Growers

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Farmstands, pick-your-own sales, and farmers' markets are the three retail outlets that come to mind when most growers consider retail marketing. There can be so much more to retail marketing than choosing one or more of these outlets, however. With annual competition for "apple dollars" increasing geometrically, each grower needs to assess his or her operation to determine strengths, weaknesses, and potential retail marketing strategies that could increase farm profitability and sustainability.

Unless we are faced with an energy crisis (i.e., fuel costs skyrocketing with trucking costs increasing as a result) global competition is a given. We will continue to see apples from other parts of the country and world impinging on local markets. Promotion, the other side of marketing, costs money. Those states that have apple marketing orders continue to use radio, television and the printed word to encourage consumers to buy their apples over your apples. When your bottom line is marginally positive, you are unlikely to consider spending money on advertising and promotion.

At the retail level, however several of the most effective avenues of promotion and advertising are virtually cost-free, the most important being satisfied customers who tell their friends about your operation or just return frequently themselves (repeat business). Contacts with local media personnel frequently result in unsolicited articles or TV spots about your farm. But, do not be afraid to call your local newspaper, radio, or TV station to tell them why they should visit your farm. A unique product, a special event, even a special employee may be worthy of media attention, and thus provide free advertising for you and your farm.

Satisfied Customers

Satisfied customers and repeat business do not just happen. Several factors play a role.

1) Quality products must be the backbone of the sales activity.
2) Consistency of quality (from visit to visit) is critical.
3) Value for the customer's money encourages repeat business.
4) Friendly, helpful, and knowledgeable employees are a must.
5) Employees with good eyes and ears, watching customer behaviors and listening to their comments, will give you insight into what you are doing right and wrong. If you are hearing the same negative comments repeatedly, correct the problem immediately.
6) Provide what your customers want. For example, if a customer wants a peck of Macouns and you are out of Macouns, do not sell him or her McIntosh and call them Macouns. If you have Macouns in the cooler, get them out. If not, suggest an alternative, and if the customer is unfamiliar with that alternative, have him or her a sample slice or a whole apple. Most customers are willing to at least try something different. Satisfied customers, remember, tell their friends. Unfortunately for you, so do unsatisfied customers.
7) Provide a suggestion box for new products, new varieties, etc., and if at all feasible, follow through. At the very least, respond to the request.
8) Above all else, provide a safe, friendly, neat, and orderly atmosphere for yourcustomers.

Promotion

Encourage customers to seek you out. Certainly all of the above will help. Some activities are low cost, but effective.

1) A unique logo for your farm that is consistent from product to product, including your value-added products (cider, jelly, etc.) and your packaging (paper or plastic and mail order boxes). Unique logos attract customers and if there is quality inside the package as well these customers will return.

2) An advertisement in a weekly (shopper's) newspaper does not need to be large, just eye-catching. The cost should be reasonable.
3) Encourage your town to develop "tourism" or agriculturally-focused literature for free distribution to visitors and residents.
4) Be sure to be included in any statewide listings of pick-your-own, farmers' markets, or roadside stands. These are distributed at tourist centers, via mail request, or often appear in articles in major newspapers, that is advertising that you would normally find expensive for free.

Be sure to include, in all of the above, whatever it is that makes your farm different, unique, or especially attractive.

Basic Sales Approaches

Let us first consider the basic three basic forms of retail marketing.

1) **Roadside or farmstand** is best situated on the farm if the farm is easily accessible or on a well-travelled highway but may be best off the farm if it is in a remote location. This type of sales often is done from a separate building that contains a sales area, preparation area, perhaps a kitchen, small seating area, and public rest rooms (a real plus) and has ample parking area. It could be quite expensive to build, and state and town regulations apply.
2) **Farmers' markets** require a suitable truck, displays, sales personnel, and market fees. The right match of location of market and products can be quite lucrative. Events staged at farmers' markets have been very successful in boosting sales; however, selling can be quite hectic at times.
3) **Pick-your-own**. Liability factors, such as ladders, uneven terrain, and big trees, are a major concern. Transportation to picking sites and standardized packaging can help prevent difficult situations from developing.

Consider one of the above as a new, or different, retail marketing strategy. A word of caution: If you are currently operating a farmstand and want to consider an additional option, do not just do it, ask yourself a few important questions first.

1) Do I have, or can I afford, the personnel needed, or the transportation, or the time to do a farmers' market?
2) Can I deal well with pick-your-own customers or will I lose my temper? Can I afford the liability insurance needed to protect my property?
3) What can I do that will fit in with what I am already doing?

Alternative Marketing Approaches

Many alternative marketing approaches have been proven to be successful in certain circumstances. Consider some of these approaches to your sales.

1) **Flea markets** are similar to farmers' markets but not specifically produce oriented. Generally, flea markets are havens for bargain hunters. Small bags of Extra Fancy fruit or larger quantities of utility or orchard run fruit may be your best options. Individual fruits, ciders, etc. may be very attractive and healthy alternatives to food concessions usually found at flea markets.
2) **CSAs** (consumer supported agriculture) are becoming popular. Consider leasing trees. Sell shares of the farm's product mix (seasonal fruits and veggies). A CSA can provide up-front money, and a guaranteed product outlet.
3) **Add-an-Event**, like harvest festivals, holiday festivals, apple tastings, cider tastings, are initially promotional, but if successful can become yearly attractions and also create repeat business.
4) **Restaurant sales** provide a "taste of your farm" for local chefs and restaurant owners. Many chefs prefer working with local, fresh, seasonal products. This is especially true if the restaurant's menu changes periodically. Encourage restaurants to feature your products (pies made from your fruits, etc.) on their menus.
5) **Institutional sales**. Work with your town's officials to encourage buying local products for schools, hospitals, jails, and businesses.
6) **Grocery stores**. Local or small chain stores may be willing to feature your products. Work with other area farmers to provide a mix of products delivered together, rather than having each farmer deliver separately.
7) **Other stands/farmers**. Offer your products to other farmers who retail through stands or farmers' markets, and do not produce the same product mix.
8) **Mail order**. Many growers already offer apple packs. What about gift packs? Many businesses give gifts to their clientele or employees at the

holidays. Often they are looking for something different, but practical. Work with a local business to develop a gift pack that is attractive to them and unique to your farm operation. Do not forget to include your name and address on the packaging.

9) **Value-added** means turning raw produce into a product of higher value, e.g., apples into apple butter, pies, or cider. Most retail marketers sell value-added products. What about something different? Cider donuts have become very popular. A grower in Tennessee decided to try apple walnut fudge. It outsold both chocolate and peanut butter fudge from the beginning. This grower also makes apple cinnamon ice cream.

Survey your customers. What product would they like to see made available? Can you provide the requested items? If not, can you work with someone who can?

Although there is little any one of us can do individually to impact profitable sales of apples on the wholesale market, undoubtedly there are other ventures that could provide additional income at the retail level. Listen to your customers and add a little creativity of your own. This may be what your farming operation needs to become more profitable. Product quality and customer service are the keys to success. Change should be occurring constantly. Anticipate consumer needs and cater to them.

Integrated Fruit Production (IFP): A Status Report

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The International Organization of Biological Control (IOBC) and the International Society for Horticultural Science (ISHS), met in Cedzyna, Poland in September to discuss the status and advances in Integrated Fruit Production (IFP). Much of the data presented in this report were summarized from Jerry Cross' (Scientific Secretary of IOBC/ISHS) presentation on the results of a survey of IFP practices in Europe presented at this meeting.

Integrated Fruit Production (IFP) is the European counterpart to Integrated Pest Management (IPM). IFP is defined by the IOBC as "the economical production of high quality fruit, giving priority to ecologically safer methods, minimizing the undesirable side effects and use of agrichemicals, to enhance the safeguards to the environment and human health." This definition takes a stronger environmental stance than many of the current definitions of IPM. Some European scientists at the IOBC/ISHS expressed the opinion that IFP-produced fruit was "safer" or "more nutritious" than conventionally produced fruit. Given the standards of horticulture and pesticide use in certain central European countries, there may be some truth to this suggestion.

General guidelines for IFP, sometimes referred to as "Euro-guidelines," are developed by representatives from all participating countries, under the guidance of the IOBC/ISHS. Guidelines include expectations for grower training, conserving the orchard environment, planting systems, soil management and tree nutrition, understory management, irrigation, fruit thinning, and postharvest handling. IOBC guidelines include requirements for record keeping and farm, storage, and packhouse inspections. Certain practices and pesticides (e.g., pyrethroid and organochlorine insecticide and acaricides, persistent herbicides, and synthetic plant growth regulators) are not permitted. Other practices or materials (e.g., benzimidazole and dithiocarbmate fungicides and sulfur) are permitted with restrictions. Pesticide residue analysis also is recommended. Each participating country or IFP organization uses the IOBC general guidelines to develop appropriate guidelines for their region.

Figure 1. Labels for Italian IFP-grown fruit (from *Lotta Integrata e Biologica*, published by the Ministero per le Risorse Agricole Alimentari e Forestali, Italy).

Table 1. Integrated Fruit Production participation in Western Europe (summarized from Jerry Cross' presentation).

Country	Total area of pome fruit (acres)	Number of IFP/QA organizations	Pome fruit in IFP/QA programs (% of total)
Austria	14,500	1	82
Belgium	49,500	2	23
Denmark	8,500	1	28
France	185,500	1	1
Germany	95,500	14	79
Great Britain*	42,000	1	76
Italy	176,000	5	53
Netherlands*	52,000	1	70
Norway*	5,500	1	1
Portugal	63,000	2	4
Spain	83,000	1	<1
Switzerland	15,000	1	71
TOTAL	790,000	31	35

* Quality Assurance Program.

Farmers who meet the guidelines developed for their region are eligible to use the regional or national IFP label (Figure 1). Currently, 35% of the pome fruit in western Europe is grown according to IFP or Quality Assurance (a related program) guidelines (Table 1), but participation in IFP varies widely among countries. Germany has 14 regional IFP organizations, certifying 79% of its apple crop, while France has one small organization, certifying less than 1% of its crop. In some regions (e.g., Switzerland, Germany, and Emilia Romagna, Italy) government or Europe Union grants provided incentives for IFP, thus influencing participation.

Cross' survey indicated differences among the various regional IFP guidelines, including departures from the established guidelines of the IOBC. Significant departures from the Euro-guidelines included postharvest treatment with antioxidants for scald by five regions, the use of residual herbicides in established orchards bytwenty regions, the use of synthetic growth regulators in four regions, and the use of a soil sterilant against nematodes in one country. It was noted that most countries do not seek endorsement from the IOBC, so these departures from IOBC guidelines do not carry any penalty.

A number of countries reported receiving price premiums for IFP-grown fruit. Premiums varied regionally. Belgium, Netherlands, and Italy reported price premiums of approximately seven cents per pound, while Austria reported a premium up to 44 cents per pound. Premiums varied throughout the season and often were not sustained. Other regions received no premiums but noted a market preference for IFP-produced fruit.

Research and status reports from all countries generally were positive about the growth and accomplishments of the IFP program. Participation in the program has grown 40% since 1991. South Africa has developed IFP guidelines, and programs are under development in New Zealand, Australia, and Argentina. In the United States, Stemilt Growers of Wenatchee, Washington have implemented a program with the same aims as IFP, and market their fruit under the label, "Growers for Responsible Choice."

A number of scientists observed that IFP-endorsement served as an incentive to growers, resulting in improvement of horticultural and pest management practices. IOBC is now working on developing IFP guidelines for stone fruit (peaches and cherries) and soft fruit (berries).

Acknowledgements

I thank J.V. Cross, Scientific Secretary of IOBC/ISHS, for providing a copy of his presentation. The complete report will be published in the proceedings of the conference. B. Borsari, of Forli, Italy, also contributed useful information.

Fruit Notes

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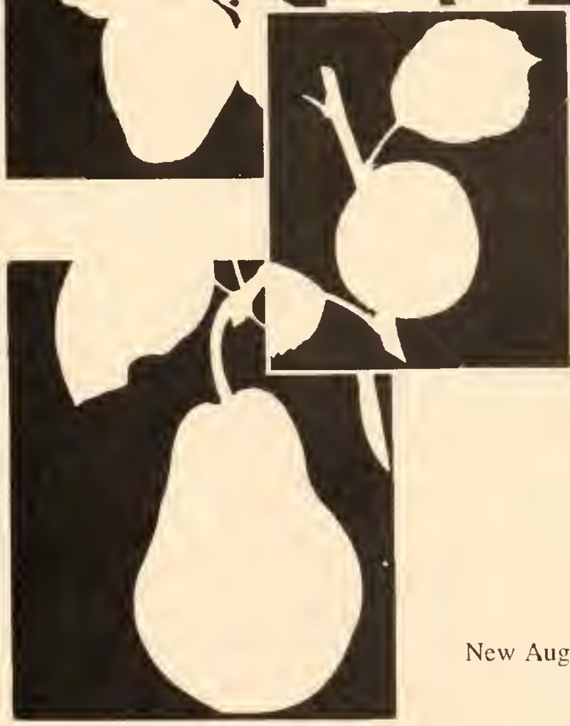

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Pioneer Mac, the McIntosh Strain of the Future?

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Pioneer Mac, technically, is not a McIntosh strain. It, however, is an open-pollinated seedling of McIntosh. It was found by Ernest Greiner (Pioneer Fruit Farms) in Marlboro, NY in 1976. Since that time, Adams County Nursery, Inc. has propagated it commercially. Even though it is not a strain but is a new cultivar, I will refer to it as a strain, since it is virtually indistinguishable from McIntosh.

Is Pioneer Mac the strain of the future? Early observations from New York suggested that Pioneer ripened later and dropped fewer fruit than standard McIntosh strains. When it was first released in 1988-89 those were very desirable characteristics, since we were in the midst of the Alar controversy. In 1988, we established a trial with the goal of characterizing the tree productivity, fruit ripening, fruit quality, and fruit drop of Pioneer Mac trees in comparison with standard McIntosh strains.

A trial was planted in the spring of 1988 at the University of Massachusetts Horticultural Research Center in Belchertown that included ten replications of Pioneer Mac, Rogers Red McIntosh, and Marshall McIntosh all on M.26 EMLA. Tree size (trunk cross-sectional area) and total yield were measured throughout the experiment. Fruit size was measured from 1992 through 1995, and red color was assessed in 1992 and 1993. Ripening was tracked with internal ethylene levels from 1990 through 1993, and natural drop was followed in 1994 and 1995.

Pioneer Mac trees were larger than Marshall trees, but were not different from Rogers trees (Table 1). Yield followed the same pattern (Table 1), but yield efficiencies of the three strains were similar (Table 1). That is, differences in yield were the result of somewhat different tree vigors and likely would not result in actual differences in yield per acre. Crop loads (fruit number per unit of tree size) were similar among the three strains for the four seasons from 1992 through 1995 (Table 1). Rogers produced the largest fruit over the same four-year period (Table 1). Color was affected significantly by strain (Table 1). Marshall fruit colored over a greater percent of the fruit surface than did the other strains, as would be expected. Pioneer fruit colored slightly (but statistically significantly) more than Rogers fruit. It is uncertain whether or not the difference between Pioneer and Rogers is practically significant.

Ripening means represent relative ripening date, that is the date when the average internal ethylene concentration of fruit reached one ppm (Table 1). Marshall fruit ripened on average three

Table 1. The effects of McIntosh strain on tree size, yield, yield efficiency, crop load, fruit size, and fruit color.

Strain	Trunk cross-sectional area, 1995 (in^2)	Cumulative yield 1990-95 (bu)	Cumulative yield efficiency 1990-95 (bu/in^2 TCA)	Crop load 1992-95 (no/in^2 TCA)	Fruit size 1992-95 (no./bu)	Red color 1992-93 (%)	Averate ripening date (1990-93)
Marshall	5.5 b	5.8 b	1.08 a	41.6 a	116 a	82 a	9/18 b
Pioneer Mac	6.9 a	7.7 a	1.15 a	47.2 a	117 a	65 b	9/21 a
Rogers	5.6 ab	7.3 ab	1.37 a	49.1 a	108 b	62 c	9/21 a

*Means within columns not followed by the same letter are significantly different at odds of 19 to 1.

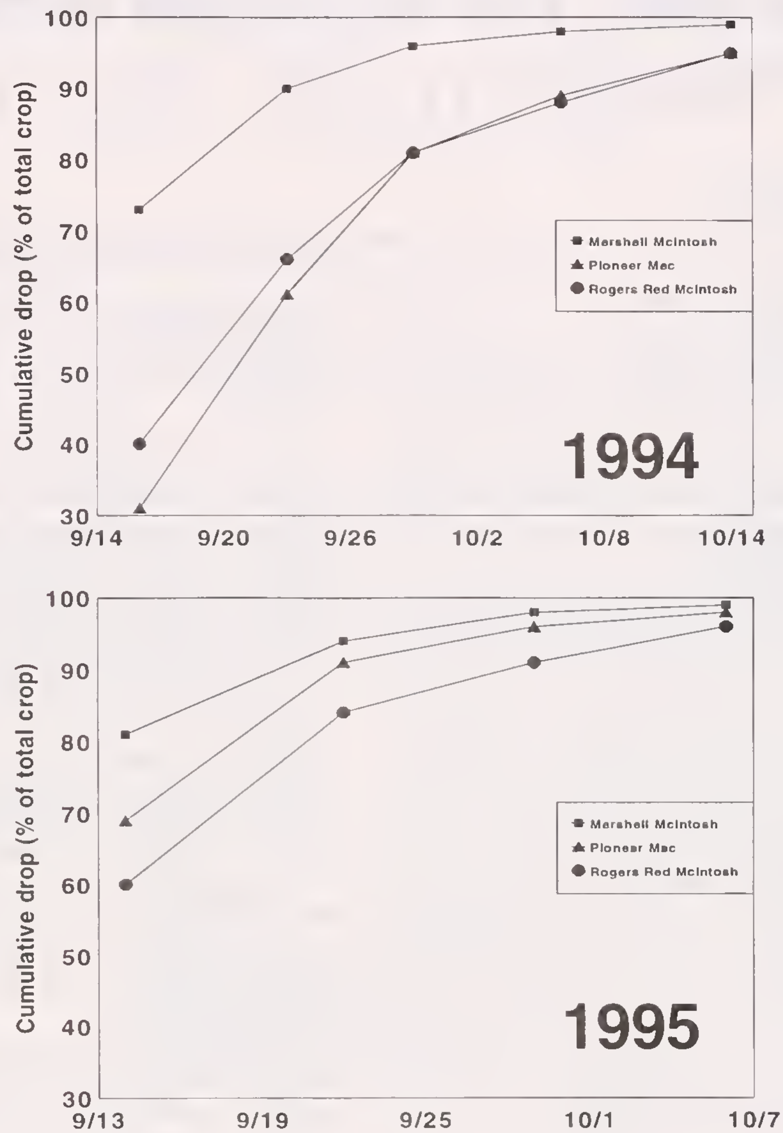

Figure 1. Cumulative fruit drop in 1994 and 1995 from Pioneer Mac, Marshall McIntosh, and Rogers Red McIntosh.

days earlier than the other strains, but there was no difference between Pioneer and Rogers.

Drop was counted under each tree weekly during the harvest seasons of 1994 and 1995 (Figure 2). In 1994, fruit dropped earlier from Marshall trees than the other two strains, but there were no differences between Pioneer and Rogers. In 1995, again Marshall trees lost fruit earliest. Rogers trees lost them the latest, and Pioneer trees were intermediate between the two.

From these data, it appears that Pioneer Mac does not have delayed ripening or drop compared to the standard strain, Rogers Red McIntosh. Does this result mean that it does not have a place in the industry? No, Pioneer is a good McIntosh. It produces a healthy tree with good productivity. Further, it colors well, possibly better than Rogers, and, although it was not measured here, there is some indication that it will produce a firmer fruit, possibly resulting in better condition out of storage.

Plum Curculio Responses to Unbaited Tedders Traps

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Over the past decade, several investigators in eastern North America have evaluated numerous kinds of traps for capturing plum curculio (PC) adults (LeBlanc et al., 1984; Yonce et al., 1995). Only one type has shown even marginal promise. It is referred to as the "Tedders" trap and was developed for monitoring pecan weevils in southeastern states (Tedders and Wood, 1994). It is in the shape of a tall thin pyramid, about 24 inches wide at the base and about 36 inches tall, colored medium gray (Figure 1). The trap base is staked to the ground to maintain an upright position. Weevils are captured when, after arrival on the trap surface, they crawl upward to the tip of the pyramid and enter a small inverted screen funnel placed over the tip, from which they cannot escape. As presently used for monitoring pecan weevils, the trap is not baited. It is placed beneath the canopy of pecan trees, where newly emerging adults beneath the tree canopy fly or crawl to the trap, apparently because they per-

Figure 1. Tedders plum curculio traps in the field.

ceive the trap as being the visual equivalent of the trunk of a pecan tree (Tedders and Wood, 1994).

To date, unbaited Tedders traps have been examined for monitoring PC adults in Georgia (Mizell et al., 1995) and Vermont (Schmitt and Berkett, 1995). In the Georgia study, substantial numbers of PCs were captured in unbaited Tedders traps placed on herbicide-treated ground between peach trees, but no comparison was made between first detection of PCs in the traps and first detection of PC feeding or egglaying activity in the trees. In the Vermont study, Tedders traps were placed on the ground cover between trees in rows of McIntosh or Liberty apples in an experimental orchard. In one of the ten plots, a PC was captured in a trap before any oviposition was observed, and in one other plot, captures and oviposition coincided in time; but in eight plots, oviposition occurred before trap capture (or there was no trap capture).

Table 1. First post-bloom evidence of plum curculio activity in apple orchards in Vermont and Massachusetts as determined by capture of adults in a Tedders trap or feeding or egglaying scars on fruit of 5 trees (Vermont) or 5-10 trees (Massachusetts) nearest the trap.

	Numbers of Sites	
First evidenceof activity	Vermont*	Massachusetts
Trap capture	1	1
Fruit scars	8	6
Both	1	3

*Data from Schmitt and Berkett (1995)

We repeated the Vermont study under Massachusetts commercial orchard conditions. In addition, we conducted several experiments aimed at finding out how PCs arrive at a Tedders trap (by flying or crawling to it) and factors influencing the probability of arrival.

Experiments and Results

Trap Effectiveness in Commercial Orchards. In each of 10 Massachusetts commercial apple orchard blocks, one Tedders trap was placed on the ground between two apple trees, within the tree row. From petal fall until 3 weeks afterward, data were collected weekly on trap captures of PCs and evidence of PC injury to developing fruit in 5-10 trees nearest the trap. The results (Table 1) were very similar to results obtained in the Vermont study by Schmitt and Berkett (1995). In one orchard, first evidence of PC activity was capture in a trap. In six orchards, first evidence of PC activity was feeding or egglaying scars in fruit. In three orchards, trap captures and fruit scars coincided in time. These data suggest that information from a single unbaited Tedders trap per 5-10 trees would not be a reliable indicator of the need for insecticide application to control PC.

Means of PC Arrival at Traps. We carried out two experiments to determine whether PCs arrive at unbaited Tedders traps by flying or crawling.

In the first experiment, conducted during the last two weeks of June, four traps were placed in short grass (1 inch tall) half-way between the trunks and perimeters of each two large (standard rootstock) unsprayed McIntosh trees. Every other trap received a thick coating of tangletrap at the base to prevent PCs from crawling onto the trap. Trap positions were reversed after the first week. All 16 PCs captured were found in those traps without sticky. None (significantly fewer) were found in the traps with sticky. These data suggest that when Tedders traps are placed beneath Massachusetts apple trees whose canopies are large and whose understory is short grass, responding PCs are likely to arrive at the trap surface by crawling and not by flight.

In the second experiment, conducted during the first two weeks of July, field-collected PC adults were released at different distances from Tedders traps in a large open field of short grass (1-3 inches tall). On each of five evenings about 2 hours before dark (when PC adults begin to become particularly active), an opened waxed paper cup containing 55 PCs was placed half-way between two traps, whose distances from the cup were either 2, 4, or 6 yards. On each test evening, the temperature was about 75°F at time of release.

The results (Table 2) show that irrespective of trap distance from point of PC release, only 3-4% of released PCs were captured in traps (there was no significant effect of distance). Of those PCs whose flight after take-off was tracked by the observers

Table 2. Response of released plum curculio adults to pairs of Tedders traps 2, 4, or 6 yards from the point of release in an open field of short grass.

Parameter	2 yds	4 yds	6 yds
Total no. released	275	275	275
Total captured after 24 hours (no.)	10	11	7
Total captured after 24 hours (%)	4	4	3
Total with flightobserved after release (no.)	25	25	16
Total observed landing on traps (no.)	2	1	0
Total observed landing on traps (%)	8	4	0

for at least 6 yards, only 8, 4, and 0% respectively, landed on traps 2, 4, and 6 yards away (Table 1). PCs were observed to climb to tips of nearby blades of grass, take off and fly in various directions. Several were noticed passing within a yard or less of a trap without landing. These data suggest that in a field of short grass (possibly equivalent to space between adjacent apple trees), only a very small proportion of the PCs present is likely to arrive at a Tedders trap two or more yards away, even when environmental conditions are quite favorable for PC activity. Some of these may arrive by flying onto the traps, others probably by crawling.

Factors Influencing Arrival at Traps. We studied the influence of two factors on the likelihood of capturing PCs in unbaited Tedders traps: height of vegetation and presence of fallen fruit in the vicinity of traps. Each factor was studied over a 2-week period from mid-August to mid-September and involved assessing responses of newly emerged PC adults that originated from larvae which infested fruit in June.

In the first experiment, four traps were placed in short grass (1 inch tall) that comprised the ground cover beneath half of the canopy of each of two unsprayed McIntosh trees. Another four traps were placed in tall broadleaf vegetation (1 foot tall) that comprised the remaining half of the ground cover beneath the tree canopies. All fallen apples within 1 yard of each trap were removed. After 2 weeks, 9 PCs were caught in the traps in the short grass compared with 8 PCs in the traps in the tall broadleaf vegetation (no significant difference). These data suggest that as long as ground cover vegetation of some sort is present beneath the tree canopy, the height of vegetation (up to 1 foot) may have little effect on PC response to traps.

In the second experiment, eight traps were placed in 1-foot-tall vegetation beneath the two McIntosh trees. Every other trap received 30 recently fallen McIntosh apples placed within 1 yard of the base of the trap. The remaining traps were kept clear of all apples within 1 yard. Treatment positions were reversed after 1 week. In all, 22 PCs were captured in traps surrounded by apples compared with 8 in traps in areas without apples (a significant difference). These data suggest that presence of food-type stimuli in association with traps could be an important contributing factor to enhancing captures of PC adults.

Conclusions

Our findings parallel the findings of Schmitt and Berkett (1995) on the current and potential value of using unbaited Tedders traps for monitoring PC adults in apple orchards: chances are high that PC injury to fruit will occur before adults are captured in the traps. Chances of capturing PCs undoubtedly could be improved by employing more than the one trap per five trees used by Schmitt and Berkett or the one trap per five-ten trees used here. Even one unbaited trap per tree may not be sufficient for accurate monitoring information, however.

Our studies of the nature of PC responses to unbaited Tedders traps suggest that only a small proportion of PCs within 2-6 yards of a trap eventually arrives at the trap. (A cautionary note here is that the data from which this conclusion is drawn are from PCs that we had released; possibly they were displaying escape behavior rather than tree finding behavior). It appears that when such traps are placed in open space (as would be the case when between tree canopies), most PCs in flight bypass

the traps. When the traps are placed beneath canopies of large trees, arrival on traps under Massachusetts conditions is largely or exclusively by crawling and not by flight. Provided there exists vegetation adjacent to traps, height of vegetation up to 1 foot does not seem to influence trap captures.

Together, these findings suggest that under Massachusetts conditions, most PCs captured in unbaited Tedders traps placed in vegetation may arrive at the traps more or less through accidental encounters, and possibly only from very close range of less than 2 yards. Success of using unbaited Tedders traps for monitoring pecan weevils and PCs in the South may be due in part to placement of traps on bare soil beneath or adjacent to orchard trees. Conceivably, PCs can perceive the silhouette of a Tedders trap much better when the ground between the PC and the trap is clean than when it has vegetation. Another factor contributing to the success of unbaited Tedders traps in the South could be a much greater tendency for PCs in the South than in the North to fly rather than crawl onto the traps. Studies in Quebec have suggested that PCs are much more prone to take flight when evening temperatures are very warm (above 80°F, as would be typical of southern evenings) than when they are cooler (below 70°, as would be typical of northern evenings).

Our final experiment suggests that Tedders traps accompanied by a resource (such as apples) of value to PCs can lead to a significant increase in trap captures. Toward this end, we are pursuing the identification of host tree volatiles and pheromonal compounds attractive to PCs so that eventually they can be used in conjunction with Tedders traps or other types of traps to create a powerful monitoring tool.

Acknowledgments

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Literature Cited

LeBlanc, J.P.R., S.B. Hill and R.O. Paradis. 1984. Oviposition in scout apples by plum curculio and its relationship to subsequent damage. *Environmental Entomology* 13: 286-291.

Mizell, R.F., D. Horton, C. Yonce, and W.L. Tedders. 1995. The Tedders trap: a simple, low-cost method to monitor plum curculio. *Journal of Economic Entomology* (in press).

Schmitt, D. and L.P. Berkett. 1995. Evaluation of a new trap for monitoring plum curculio in New England apple orchards. *Proceedings of the New England Fruit Meetings* 101: 109-113.

Tedders, W.L. and B.W. 1994. A new technique for monitoring pecan weevil emergence. *Journal of Entomological Science* 29: 18-30.

Yonce, C.E., D.L. Horton, and W.R. Okie. 1995. Spring migration, reproductive behavior, monitoring procedures and host preference of plum curculio on *Prunus* species in central Georgia. *Journal of Entomological Science* 30: 82-92.

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Attraction of Plum Curculio Adults to Host-plant and Pheromonal Extracts

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Plum curculios (PCs) use odor to locate individual host fruit at close range (Butkewich and Prokopy, 1993, *J. Chem. Ecol.* 19:825-835). PCs, like other weevils, also may be attracted to pheromones produced by the same or opposite sex. In 1995, we began to test PC attraction to various plant odor and pheromonal extracts using a simple bioassay. In 1995, we conducted bioassays of PC responses to extracts of (1) host and nonhost plants, (2) wild plum and McIntosh fruit at different stages of development, (3) parts of McIntosh trees, and (4) whole bodies of PC females and males.

Materials and Methods

Hexane extracts were made from fruit collected two weeks after bloom from the following plant types: McIntosh trees, mountain ash trees, barberry bushes, dogwood bushes, and honeysuckle bushes. We also made extracts of blossoms or fruit collected from wild plum and McIntosh trees at the following stages of development: bloom and one, two, three, four, and five weeks after bloom. Further, we made extracts of McIntosh fruit, twigs, and leaves collected one and four weeks after bloom. Hexane, pheromonal extracts were made from whole bodies of female or male PCs starved for 24 hours.

PCs used in bioassays were collected from unsprayed wild plum and apple trees. For all plant odor tests, PCs of mixed sexes were starved 24 hours prior to testing. Tests were conducted at the beginning of darkness. One PC was placed into each test Petri dish and allowed to move toward volatiles emitted from either a plant odor extract in hexane or hexane alone (as a control). For all pheromonal extract tests, one PC known to be female and starved 24 hours prior to testing was placed into each test Petri dish and allowed to move toward either a pheromonal extract in hexane (amount equivalent to that extracted from one female) or hexane alone (as a control). PCs were allowed 2 hours to respond.

To measure the power of a treatment (i.e., the power of a potentially stimulating odor) we used a Response Index (RI). The RI was calculated by subtracting the number of PCs responding to the control from the number responding to the treatment, dividing this amount by the total number of PCs tested, and multiplying by one hundred. The greater the RI value, the more attractive was the stimulus. We considered a RI value of 25 as the minimum for suggesting attractiveness.

Results

Extracts of McIntosh fruit two weeks after bloom (RI = 38) proved much more attractive to PCs

Table 1. Numbers of adult plum curculios moving to the treatment or control or remaining in the Petri dish, and subsequent Response Indices, during 2 hours of exposure to extracts of fruit of host (McIntosh) and nonhost (all others) plants two weeks after bloom.

Plant	Treatment	Control	Dish	Response Index
McIntosh	14	5	5	38
Mountain Ash	12	10	2	8
Dogwood	11	9	4	8
Barberry	8	6	10	8
Honeysuckle	10	11	3	0

Table 2. Numbers of adult plum curculios moving to the treatment or control or remaining in the Petri dish, and subsequent Response Indices, during 2 hours of exposure to extracts of McIntosh or wild plum fruit of different stages of development (bloom or one to five weeks after bloom).

Fruit	Stage	Treatment	Control	Dish	Response Index
McIntosh	Bloom	8	3	1	42
	One week	6	1	5	42
	Two weeks	6	2	4	33
	Three weeks	7	1	4	50
	Four weeks	7	1	4	50
	Five week	3	3	6	0
Wild plum	Bloom	12	6	6	25
	One week	15	1	8	58
	Two weeks	15	1	8	58
	Three weeks	12	5	7	29
	Four weeks	11	5	8	25
	Five week	6	5	13	4

than extracts of fruit of four nonhost plants two weeks after bloom (RI = 0-8) (Table 1). Extracts of McIntosh blossoms or fruit at one, two, three or four weeks after bloom were about equally attractive to PCs (RI = 33-50) and were more attractive than extracts made five weeks after bloom (RI = 0) (Table 2). Extracts of wild plum fruit made one or two weeks after bloom (RI = 58) were more attractive than extracts of wild plum blossoms or extracts of fruit made three or four weeks after bloom (RI = 25-29) or five weeks after bloom (RI = 4) (Table 2). Extracts of McIntosh fruit, leaves and twigs were about equal in attractiveness to PCs when made one week after bloom (RI = 39-44) (Table 3). When made four weeks after bloom, extracts of McIntosh fruit and leaves were about equally attractive (RI = 42-48), whereas extracts of twigs were rather unattractive (RI = 17) (Table 3). Extracts of whole bodies of PC females (RI = 45) and males (RI = 31) were similarly attractive to PC females (Table 4).

Table 3. Numbers of adult plum curculios moving to the treatment or control or remaining in the Petri dish, and subsequent Response Indices, during 2 hours of exposure to extracts of McIntosh twigs, leaves or fruit collected one or four weeks after bloom.

Stage	Plant Part	Treatment	Control	Dish	Response Index
One week	Fruit	20	4	12	44
	Leaves	18	4	14	39
	Twigs	17	1	18	44
Four weeks	Fruit	21	4	11	48
	Leaves	19	4	13	42
	Twigs	15	9	12	17

Conclusions

We postulated at the outset that PCs could exhibit greater attraction toward extracts of host fruit than extracts of nonhosts fruit. Our results supported this hypothesis and suggest that host plants emit particular attractive compounds or blends of compounds that are not characteristic of nonhost plants. Peak attractiveness of wild plum fruit (the native host of PC) occurred one to two weeks after bloom. Peak attractiveness of McIntosh fruit extended to four weeks after bloom. Neither wild plum nor McIntosh fruit were attractive five weeks after bloom. Interestingly, compounds present in McIntosh trees attractive to PCs appear to be emitted rather equally by fruit, twigs, and leaves one week after bloom and by fruit and leaves four weeks after bloom. Finally, the finding that extracts of whole bodies of each sex of PC were attractive to PC females suggest the existence of attractive pheromone.

Together, the findings presented here strongly suggest that synthetic equivalents of odors of host plants (particularly of fruit, twigs and leaves one

Table 4. Numbers of female adult plum curculios moving to the treatment or control or remaining in the Petri dish, and subsequent Response Indices, during 2 hours of exposure to extracts of whole bodies of females or males.

Extracts	Treatment	Control	Dish	Response Index
Females	37	5	29	45
Males	34	11	28	31

or two weeks after bloom) and odor of PCs themselves have potential value for use in traps to monitor or control PCs. If findings with other weevils can serve as a guide, a combination of host plant and pheromonal odors will prove more attractive than either type alone. Our next step will be confirmation of the findings reported here, followed by attempts to chemically identify the attractive compounds.

Acknowledgments

This work was supported by grants from the USDA Sustainable Agriculture Research and Education Program (SARE), the USDA Northeast Regional IPM Competitive grants program, and the New England Tree Fruit Growers Research Committee.

* * * * *

Can Sprays of Fatty Acids Repel Plum Curculios?

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Some insects seem to be able to recognize same-species death, possibly because of the presence of unsaturated fatty acids in the remains. This recognition has been shown by research with cockroaches, ants, and earwigs. Conceivably, unsaturated fatty acids may be useful as a pest-control agent. Here, we applied different concentrations of unsaturated fatty acids (oleic, linoleic and linolenic) dissolved in methanol to freshly picked wild plums to determine if these substances would repel feeding or oviposition by adult female plum curculios.

Wild plums were picked from trees located on the campus of the University of Massachusetts and brought directly to the laboratory. Fatty-acid solutions were made from oleic, linoleic and linolenic acid dissolved in methanol at four concentrations: 10.0 mg/ml, 1.0 mg/ml, 0.1 mg/ml, 0.01 mg/ml. Twelve replications at each concentration were prepared. For each replicate, the treated plum was coated with a fatty-acid solution. The control plum was left uncoated. A treated and an untreated plum were placed under a small plastic cup together with one adult female plum curculio. Each adult was able to forage freely on either the treated or untreated plum. Plums were checked 24 hours later for evidence of feeding or oviposition. Numbers of plums with feeding and oviposition scars were counted for each replicate.

Contrary to our proposed hypothesis, it appears from our results that applications of fatty acids on the surface of wild plums did not reduce feeding or oviposition by adult female plum curculios (Table 1). Although other insect species may recognize fatty acids present in dead individuals and be repelled by such compounds, plum curculio adults in our laboratory have been observed to crawl over and feed in close proximity to such individuals. The fatty acids tested here do not appear to elicit a repellent response in plum curculio and have little or no promise as control agents for this important pest.

Acknowledgments

This work was supported by grants from the USDA Sustainable Agriculture Research and Education Program (SARE), the USDA Northeast Regional IPM Competitive grants program, and the New England Tree Fruit Growers Research Committee.

Table 1. Feeding and oviposition by adult female plum curculios on treated, untreated, or both plums after treatment with different concentrations of fatty acids.

	Plums with feeding scars (no.)			Plums with oviposition scars (no.)		
Treatment (mg/ml)	Treated only	Control only	Both	Treated only	Control only	Both
10	6	7	0	6	7	0
1	7	2	2	5	1	1
0.1	8	1	1	3	0	5
0.01	5	5	0	3	6	0

New August-ripening Apple Cultivars That Are Alternatives to Paulared

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Paulared is the most extensively planted apple cultivar that ripens in late August. It is large, attractive, and red, and at its very best, it is good. Under many circumstances, however, it has only fair quality. Recently, several new apple cultivars have been named and released that ripen at a similar time to Paulared. The purpose of this article is to present these as potential alternatives in the pre-McIntosh season.

Evaluations were done on fruit that were from trees three to six years old. Evaluations were conducted for three seasons. Within each season, ten fruit were harvested from each cultivar at weekly intervals for up to five weeks. At each harvest, flesh firmness, percent red color, circumference, weight, soluble solids, and starch degradation were measured. Also, fruit were evaluated for visual and sensory characteristics. In 1994, some fruit were harvested when the starch rating was four to five and placed in regular storage for periodic postharvest evaluation. Tables 1-6 summarize fruit characteristics and storage results.

Paulared

Paulared is the first apple of the season to be harvested in significant volume in New England. It is large, blush red, and very attractive, and it is probably the first good apple available that has the potential to maintain good condition for more than several days on grocery shelves. It is slightly tart and it has no better than good flavor. Unlike many other cultivars, keeping Paulared apples on the tree until they reach full maturity does not improve their flavor. Therefore, Paulared frequently is harvested when it reaches an acceptable level of red color. It has a moderately good storage life, but because quality is inferior to Jonamac or McIntosh, Paulared fruit remaining in storage after the start of Jonamac or McIntosh harvest is a liability.

Ginger Gold

Ginger Gold is the first and best, early yellow apple. It can be harvested green in Paulared sea-

Table 1. Characteristics of several early-maturing apple cultivars.

Characteristics	Paulared	Ginger Gold	Sunrise	Sansa
Parentage	Seedling	Seedling	McIntosh × Golden Delicious	Gala × Akane
Harvest	Aug 20-30	Aug 20-Sept 12	Aug 16-26	Aug 20-Sept 12
Skin color	Red blush	Green turning to yellow	Red stripe	Blush red on green yellow
Flesh color	White	Cream	White to cream	White to yellow
Freeze size	Medium to large	Medium to large	Medium to large	Small to medium
Fruit shape	Round to oblate	Oblate	Oval-round	Round
Tree vigor	Vigorous	Very vigorous	Moderately	Slightly weak

son or left on the tree to mature and ripen to an attractive lemon-yellow color. Ginger Gold has a very mild flavor and a smooth, nonrusseting skin. Ginger Gold maintains condition on the tree remarkably well over a three-week period (Table 3). Storage potential appears to be relatively short. Fruit harvested on September 2 and kept at 32°F had a firmness below 13 pounds and were only rated fair less than six weeks later (Table 4).

Table 2. Sensory evaluations* of several early-maturing apple cultivars.

Cultivar	Attractiveness	Flavor	Overall
Paulared (8/23-8/30)	6.9	5.7	6.0
Sunrise (8/17-8/30)	7.2	6.6	6.8
Ginger Gold (8/23-9/11)	7.4	7.0	7.2
Sansa (8/23-9/11)	7.2	7.3	7.3

*5-6 = good, 6-7 = very good, 7-8 = excellent.

Table 3. Effects of harvest date on Ginger Gold.

Harvest date	Starch (rating)	Firmness (lbs.)	Overall rating
Aug. 24	1.0	22.3	6.2
Sept. 2	1.8	20.8	7.2
Sept. 7	2.2	21.0	7.8
Sept. 13	3.3	19.8	7.6

Sunrise

Sunrise is a very attractive apple that matures to a beautiful striped red color. Like many early-maturing apples, Sunrise has limited storage potential when fruit are allowed to develop good red color on the tree. Fruit must be harvested when the ground color is somewhat green, and even then, the shelf life is limited. Sunrise has an extremely mild flavor, and when harvested at the proper time, is very crisp and juicy. The window of harvest anduse of Sunrise is narrow, but when utilized during this period of time, it is a very nice apple.

Sansa

Sansa ripens in late August through early September. Fruit quality is remarkably similar to Gala, not surprising since Gala is one of the parents. It is only medium in size, but it has outstanding flavor. It is crisp, juicy, and has very good flavor at the time when Paulared is harvested. Like Ginger Gold, it keeps well on the tree for up to three weeks (Table 5). When tree ripened, it develops a very fruity tropical taste and has a pleasant aroma. It has a modest storage potential (Table 6).

Unlike many other apples, even when somewhat soft, it is still a pleasure to eat. When flesh firmness approaches 12 pounds, Sansa is very pear-like in feel and taste. Vegetatively, the growth is moderately weak. It also carries a gene for a mosaic leaf characteristic, which further makes the tree appear weak.

Ginger Gold, Sunrise, and Sansa are three newly-named cultivars that ripen in the Paulared season. All three apples are vastly

Table 4. Effects of time in regular storage on the quality of Ginger Gold apples.

Date	Flesh firmness (lbs.)	Comments
Sept. 2	18.8	Excellent
Sept. 22	15.7	Softening (9.5-18.5)
Oct 13	12.9	Slightly grainy, fair
Nov. 18	11.5	Grainy, poor

Table 5. Effects of harvest date on Sansa apples.

Harvest date	Starch (rating)	Firmness (lbs.)	Overall rating
Aug. 24	2.5	16.7	7.5
Sept. 2	5.0	16.2	7.0
Sept. 7	5.6	17.8	7.3
Sept. 13	6.8	16.3	8.9

superior in taste to Paulared, and they provide marketing potentials that should be explored. Apples harvested during this period of time should be evaluated for their potential in the season up to McIntosh and Gala harvest. Sunrise has the shortest shelf life so planting of this cultivar should be limited to fruit that can be sold within a two-week period. Both Ginger Gold and Sansa hold well on the tree, and they maintain outstanding quality on the tree. We strongly urge growers to increase their potential for early apples sales by planting some of these alternatives now.

Table 6. Effects of time in regular storage on the quality of Sansa apples.

Date	Flesh firmness (lbs.)	Comments
Aug. 26	17.2	Excellent
Sept. 15	15.9	Very good
Oct. 7	13.7	Very good
Nov. 18	12.6	Soft, good

* * * * *

Tax Pointers for Farmers and Landowners in 1995

P. Geoffrey Allen
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Tax advice given below is intended as general advice and is believed to be correct. It does not substitute for a detailed review of the circumstances of an individual taxpayer by a professional tax practitioner. For more details, you and your tax adviser may wish to consult the sources referenced in the square brackets [thus] (see footnote) .

New Tax Legislation

No new federal tax legislation was passed in the last year. The most important tax bill, H.R. 1215, passed the House on April 5, 1995. Portions of the bill may appear in the final Budget Reconciliation Act. The main proposals of the bill are well known but may not become law in their original form. For example, the proposed $500 tax credit for each dependent child may be modified or eliminated.

In terms of planning, it seems reasonable to expect that capital gains taxes (except on corporations) will be reduced in that 50% of long-term capital gains will be deducted from income. Long-term losses will be deductible at a rate of $2 for each $1 of ordinary income up to an annual limit of $3,000 of ordinary income. Capital gains may or may not be indexed. There is some remote chance that the effective date of the change will be backdated to 1995, but the confusion for taxpayers and the need to file amended returns makes backdating earlier than January 1, 1996 unlikely. If you can delay a sale that will subject you to capital gains or losses, the best advice is to wait until legislation is passed into law.

H.R. 1215 also contains provision for the Section 179 deduction to be increased in steps up to $35,000 in 1999 ($22,500 in 1996). While this is unlikely to alter your planned capital investments, you may want to consider the hint in the next section.

The Commonwealth of Massachusetts has passed a bill to permit the setting up of Limited Liability Company (LLC's) and Limited Liability Partnerships (LLP's) (H. 4045, signed by the Governor, as Chapter 281 of the Acts of 1995 on November 28, 1995). Only one state (Vermont) has still to pass similar legislation. From January 1, 1996, existing business entities and new ventures will be able to set up as LLC's or LLP's. Owners gain the protection of limited liability and the flexibility of partnerships in making distributions and allocations of income and assets. For an existing partnership, conversion to LLC or LLP limits the liability of the general partners. For an existing corporation, the advantages of conversion are less clear. There will be federal tax consequences for existing corporations (subchapter C or subchapter S) who choose to convert to an LLC. Partnerships generally should have tax-free conversion assuming all assets and liabilities are transferred to the LLC, the LLC continues the activity or business and the partners have the same ownership. The advice of a qualified tax practitioner and of an attorney should be sought if you are considering LLC or LLP status.

Repair or Improvement?

Taxpayers and the IRS often have different views about whether an expenditure on an existing building or machine is a repair or improvement. Taxpayers would like the immediate deduction of repair expense and the IRS would like to see the expense depreciated over a number of years. A capital expense: adds to the value of the land, building or machine, or substantially prolongs its life, or adapts the property to a new or different use, or restores the property. A repair: does not materially add to the value of the property, does not appreciably prolong its life, and is an expense that keeps the property in efficient operating condition [Treas. Reg. 1.263 (a) and (b), 1.264]. Hundreds of tax court cases have further refined the distinction. For example, replacing a broken transmission in a tractor with a used transmission is a repair. Rebuilding an existing transmission using new or rebuilt parts in place of existing worn parts is an improvement.

If the transmission rebuilding was relatively inexpensive, you might claim that it did not materially add to the value of the tractor. For peace of

mind on such judgement calls, one IRS Revenue Agent suggested the following. Treat expenses that fall in the grey area between repair and improvement as capital expenditures. Then, provided that they are on property that qualifies for section 179 deduction, take the entire amount as a section 179 deduction.

More on Section 179 Deduction

Joint Ownership. For example, three individuals (not related, not partners) each pay 1/3 the cost of a combine. Each uses it on his or her individually managed farm. Each owner is entitled to claim the maximum section 179 deduction (currently $17,500) in the year of purchase.

Remember that the section 179 deduction can be claimed on tangible personal property used in your trade or business and on single-purpose livestock buildings, greenhouses, and mushroom sheds used in commercial production. The cost of the asset less the amount of the section 179 deduction is the unadjusted basis on which depreciation is figured. There are some limitations. For example, equipment purchased by a son from a father, or from another brother, does not qualify for the section 179 deduction.

Health Insurance

As a self employed individual, you can now deduct (as an adjustment to income on Form 1040) 30% of the amount paid for health insurance coverage for yourself, your spouse, and your dependents. The 30% rate applies to 1995 and later years. Eligibility conditions are unchanged. You are ineligible to take the deduction for any month in which you are also an employee and your employer offers a subsidized health plan. You are also ineligible if you could participate in a plan offered by your spouse's employer.

The 30% rate also applies to a general partner or a limited partner receiving guaranteed payments and to a shareholder who owns more than 2% of the outstanding stock in an S-corporation. The amount of premium paid by the partnership or corporation is a deductible expense to the business and is taxable income to the person insured [IRC 162(l), and Self Employed Health Insurance Act (PL 104-7)].

Health and accident insurance provided to employees can be claimed as a deduction by the employer on Schedule F and does not have to be included in the employee's income [IRC 105(b)].

A self-insured plan (in which the employer reimburses the employee's medical expenses) is subject to non-discrimination requirements. It must be in writing and must serve all employees (with certain exclusions). A plan purchased from a third party (an insured plan) does not have a non-discrimination requirement. A sole proprietor can enrol an employee spouse in an insurance plan that provides coverage for family members and deduct the full amount as a business expense.

Self Employment Tax for a Partner

A general partner in a limited partnership is subject to SE tax even though he or she performs no services or does not materially participate. There are some exceptions for retired general partners with many restrictions.

Figuring Estimated Tax

In figuring "2/3 gross income from farming" for estimated tax purposes, gain from sales of machinery on Form 4797 is not included but gain (not loss) from sale of livestock for draft, breeding, sport, or dairy is included.

Office in the Home

A home office on a farm where the office is used regularly and exclusively for the farm business is entitled to home office deductions.

Deductions for Cars and Trucks Used in Business

Passenger automobiles are treated differently from trucks. Passenger automobiles are listed property, as are vans or trucks of 6,000 pounds gross vehicle weight or less [IRC 280F(d)(5)(a)]. Many, but not all, pick-up trucks fall in the listed property category. Also, one truck may be under 6,000 pounds GVW while another truck of the same model and manufacturer but with different manufacturer's options may be over 6,000 pounds GVW.

Farm trucks would be depreciated at the MACRS rate (as 5-year property) except depreciation of farm trucks may be limited because:

1. Truck is under 6,000 pounds gross vehicle weight (as rated by the manufacturer). Such a vehicle is listed property. For vehicles placed in service in 1995, the limitsof depreciation and section 179 deduction combined are $3,060 in

1995, $4,900 in 1996, $2,950 in 1997, and $1,775 in later years [IRC 280F(a)(1)(A)].

2. Truck is listed property and is used 50% or less in a trade or business. The depreciation is then limited to the (slowest) alternative MACRS rate [IRC 168(g)]. Business use that exceeded 50% of total then fell below 50% requires the taxpayer to recapture the depreciation in excess of alternative MACRS rate.

For listed property, to claim an expense, you must keep records showing the amount of the expense, time and place of travel, and business purpose of the trip. A special concession for farmers is that without any record keeping a farmer can claim 75% of the use of a vehicle as business use if vehicle is used during most of business day directly in connection with the business of farming. This claim must be elected on the first return filed after the vehicle is placed in service, otherwise it can never be claimed for that vehicle. With proper records, more than 75% might be claimed as business use. IRS interprets the election for undocumented 75% business use as applicable to one vehicle only [Temp. Reg. 1-274-67(b)].

The standard mileage deduction can be claimed (on line 12 of Schedule F) only if no more than one vehicle is used in the trade or business at the same time. (And the fuel, etc. used in the vehicle should not be claimed as an expense elsewhere on the return.)

Irrigation Systems and Wells

If actively used in farming, irrigation systems and wells are depreciable property (and therefore eligible for section 179 deduction). Wells that provide water for poultry and livestock, lined or unlined, were held to be tangible property, and therefore depreciable [Rev. Ruling 72-222]. An irrigation system with fixed pumps and underground pipes also is depreciable [Rev. Ruling 75-151]. Pumps and sprinklers have 7-year lives under MACRS. Wells and underground pipes have 15-year lives.

Owners of Small Woodlots

The owner of a small woodlot generally is not holding the timber primarily for sale as part of a business. This causes the sale to be treated as a capital gain on Schedule D. Sale costs also are deductible on Schedule D.

If timber is held for investment the owner can arrange for selective cutting and still get capital gains treatment. But frequent sales and high income sales may negate the capital gains-treatment. The owner who personally cuts the timber or sells it as cut, rather than on the stump, is consider in the timber business. In this case, timber is included in a special category subject to capital-gains treatment.

At time of purchase of a timber stand, allocate the purchase between land and timber and report this on form T. Otherwise the value at time of purchase will have to be determined retroactively from current information.

Costs of removing trees or hedgerows are regarded as one time expenses and must be added to the tax basis of the land. Only if these expenditures were for the purposes of soil or water conservation may they be treated as currently deductible. However, expenses that occurregularly such as cutting back encroaching trees or brush to maintain production on land are deductible currently.

Renting from Spouse May Reduce FICA Tax

Payment of rent to spouse is a device that may reduce FICA tax. The spouses must have a bona fide landlord-tenant relationship. The landlord spouse should preferably own the land (though joint ownership with the tenant spouse is possible), should charge fair market rent, should execute a lease, should keep rent income separate from funds used in farm operation and must avoid material participation in the farming business. If all these conditions are met the rent is reported on Schedule E where it is not subject to FICA tax.

Payment of Wages with Commodities Avoids FICA Tax But Not Income Tax

Remuneration paid in any medium other than cash for agricultural labor is excluded from wages subject to FICA taxes [IRC 3121(a)(8)(A)]. That is, the transfers are not equivalent to cash. In 1994, the IRS issued guidelines for when a transfer of property constitutes non-cash payment for labor. The guidelines are a narrow interpretation of IRC 3121(a)(8)(A) and are not binding, but departures are likely to be challenged by the IRS.

1. Exercise of dominion and control by employee is required for bona fide non-cash transfer.

Documentation of the transfer arrangements will help establish the bona fide nature of the transaction. The employee must be responsible for marketing the commodity. Sale back to the employer will negate absolutely the non-cash nature of the transaction. The employee must assume risk of gain or loss. Stating the transfer as equivalent to a set dollar amount will negate the non-cash nature.

2. Cash equivalency. In addition to the factors under item (1), there are other factors. If the employer makes a cash advance that is to be satisfied on sale of a commodity, the advance will be considered wages. If the employee immediately converts the commodity to cash, it will be treated as cash. If the in-kind payment is the only income an employee receives it will be treated as cash unless the employee can show that the commodity was held for some length of time. Non-cash wages are exempt from FICA but are subject to income tax. They should be reported in box 3 of Form W-2 at the fair market value at the time of the transfer. This is also the amount that the employer can deduct as a business expense.

Footnotes

Explanation of abbreviations in citations: [IRC], Internal Revenue Code section number; [Rev. Ruling], IRS Revenue Ruling; [Temp. Reg.], IRS temporary regulations; [Treas. Reg.], IRS final regulations.

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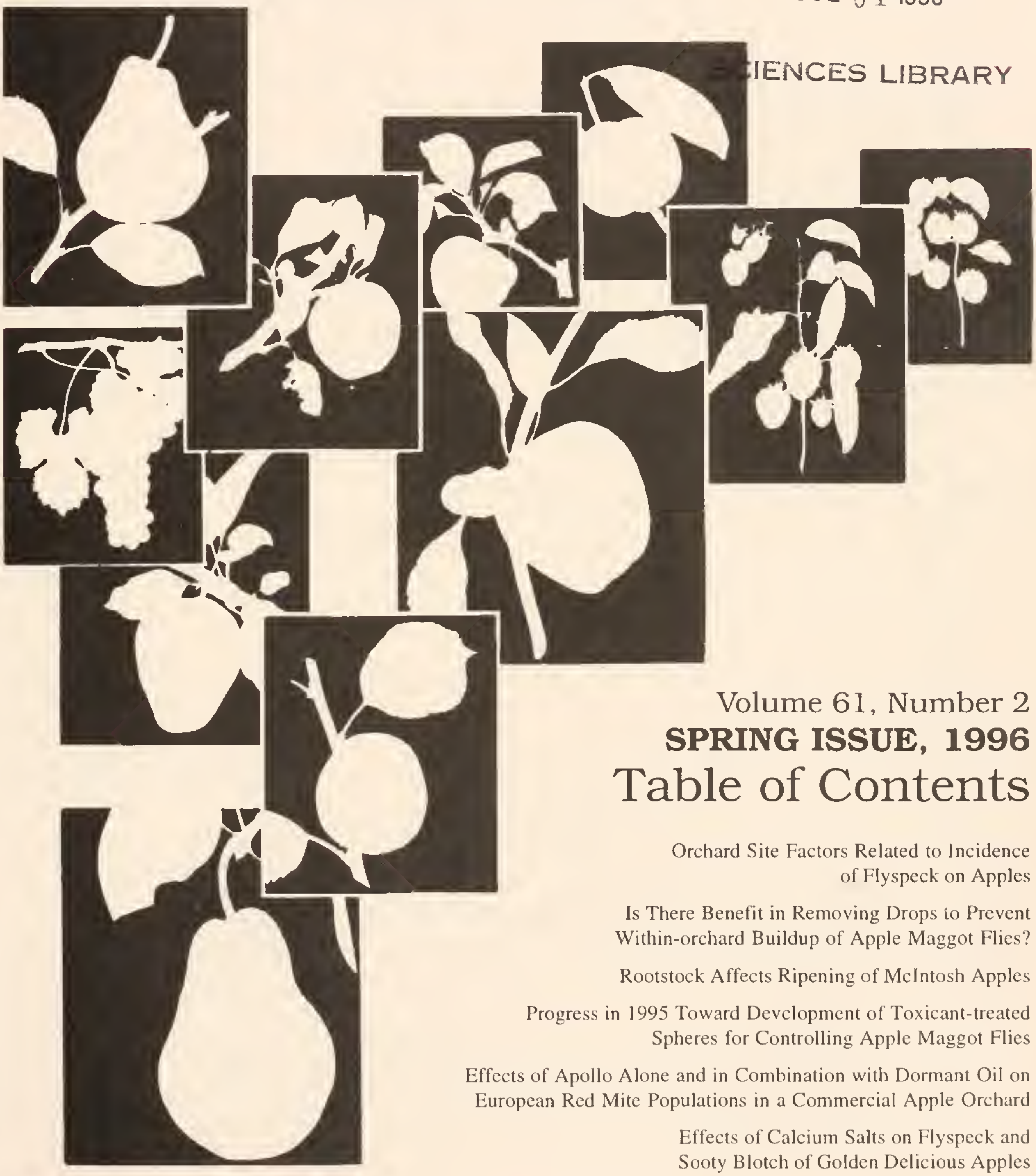

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UMASS EXTENSION POLICY:

Orchard Site Factors Related to Incidence of Flyspeck on Apples

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As part of our efforts to examine the effects of the elimination of summer fungicide applications on apple diseases and arthropod pests, we focused on the key summer disease, flyspeck (caused by *Zygophiala jamaicensis)*. During the summer of 1995, six growers were asked to refrain from spraying fungicides on prescribed sections of their orchards from the end of the primary apple scab season through harvest. These 51 blocks were selected to represent varying distances from sources of inoculum. In addition, each block was assessed for other characteristics, such as elevation, slope, and canopy density. Inoculum density parameters, including the density of a major reservoir host (*Rubus* spp.) and the amount of flyspeck on the host, were measured also. A comparable check block was chosen for each test block. Flyspeck incidence was recorded weekly in each block over an eight-week period from 24 July to 15 September by sampling 200 fruit per block.

Several factors had a significant effect on flyspeck incidence. Not surprisingly, date, grower, and treatment with fungicides all had significant effects on flyspeck incidence (Tables 1 and 2). Fungicide-treated blocks had much less disease than the test blocks, and disease incidence increased rapidly during early August (weeks 3 and 4). Obviously, different growers have different fungicide programs, and this can explain the variation between fungicide-sprayed trees in orchards. But there is also variation between orchards for trees which were not sprayed. Other factors must account for these differences. We looked at a number of these in the test blocks.

As in other experiments, foliage density in the canopy had a significant effect on flyspeck incidence, with more dense foliage leading to higher flyspeck incidence. Yet several other factors also contrib-

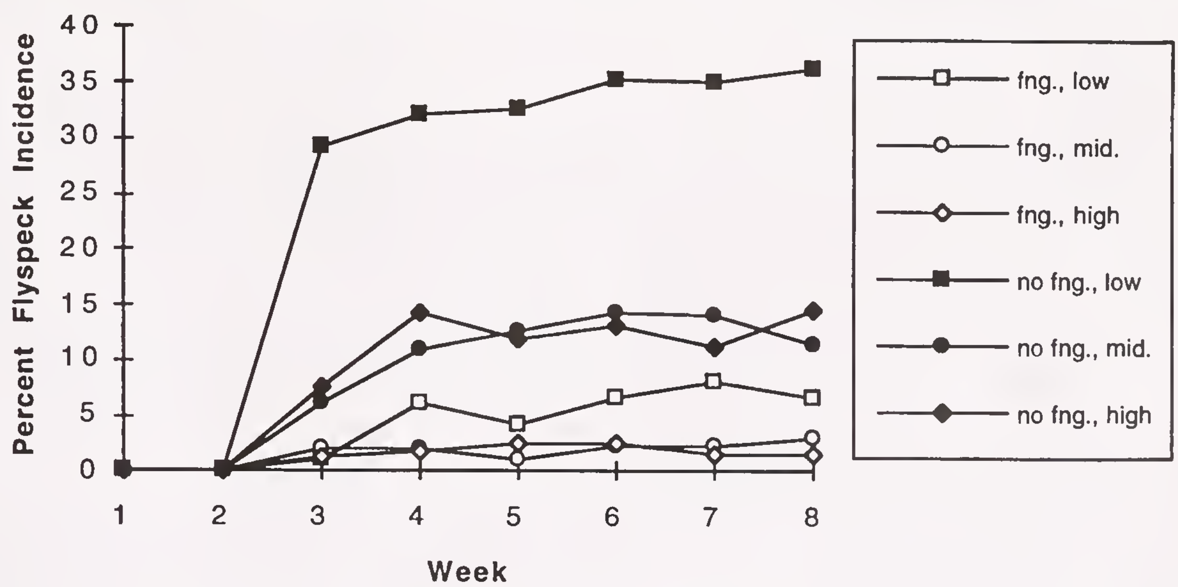

Figure 1. Flyspeck incidence in all grower blocks at different relative altitudes within the orchard, for fungicide-treated and non-fungicide trees.

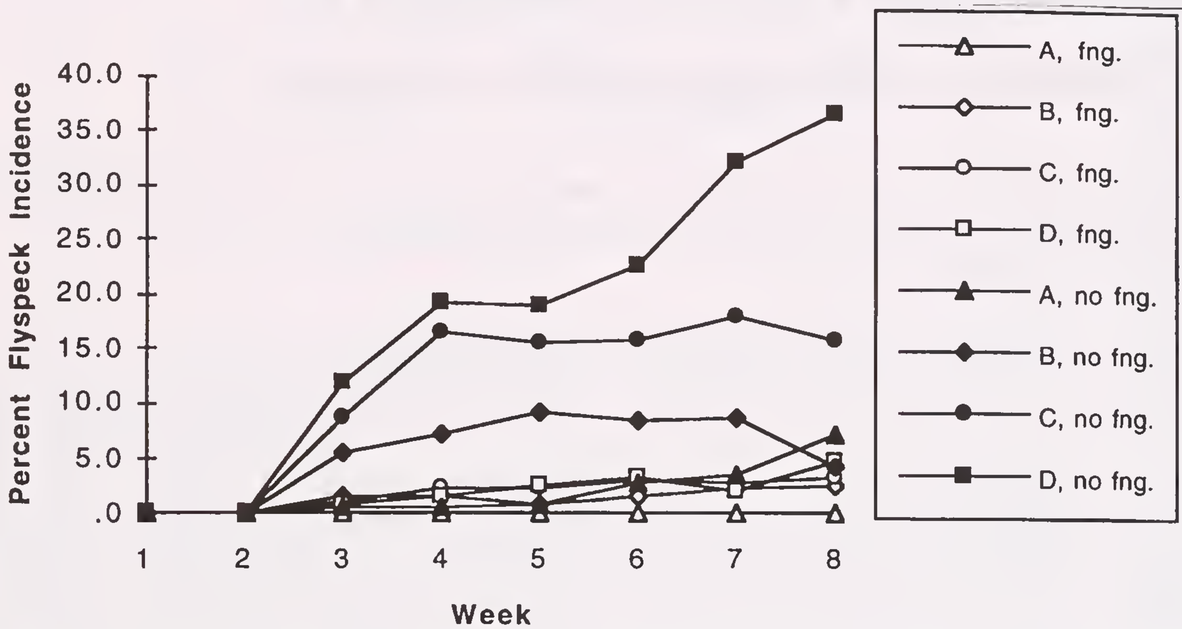

Figure 2. Flyspeck incidence as over all blocks for various bramble densities for fungicide-treated (fng.) and non-treated (no fng.) trees. The bramble densities were rated along the border nearest the test area, and A = no to a few scattered canes; B = few canes in scattered patches; C = line of canes along border edge; D = solid area of canes.

Table 1. Difference in flyspeck incidence in different orchards.

	Flyspeck by orchard (% incidence)					
Treatment	1	2	3	4	5	6
Fungicide	0.0	0.2	1.2	1.4	3.0	4.1
No Fungicide	0.1	3.6	7.0	4.7	3.3	32.6

uted to flyspeck incidence in these blocks: the relative altitude of the block within the orchard, the amount of slope in the block, the distance to the border, and inoculum density on the border brambles. The relative altitude in the orchard proved to be a surprisingly important factor. The test blocks in the lower parts of orchards had significantly more flyspeck than the blocks which were at the higher parts of the orchard (Figure 1). This could relate to factors such as wind which would encourage more rapid drying in blocks which were higher up. The relative altitude of the trees made only a slight difference when fungicides were applied.

The density of the blackberry canes in the orchard border also affected flyspeck incidence. As the bramble density increased, so did flyspeck incidence (Figure 2). This may be related to increased inoculum supplied by flyspeck on the canes, or it may simply be an indicator of dense border areas with less air circulation. Again, if fungicides were used, the effect of the

Table 2. Effects of date on flyspeck incidence in fungicide-sprayed and non-sprayed apples.

Treatment	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8
Fungicide	0.0	0.0	0.8	1.4	2.0	3.4	2.2	2.6
No Fungicide	0.0	0.0	6.4	11.2	11.4	12.9	15.9	14.6

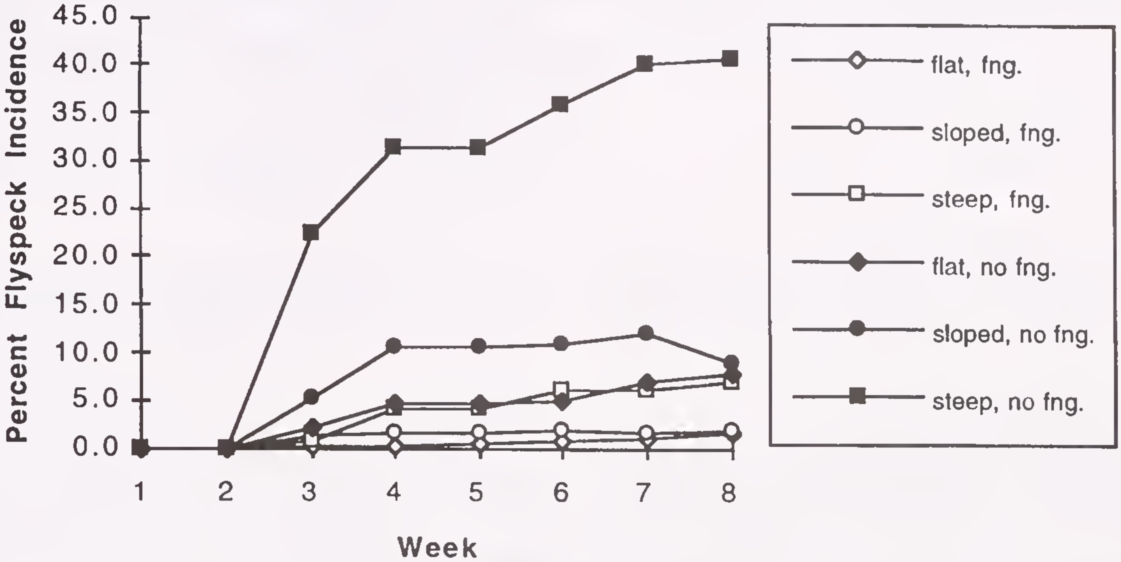

Figure 3. Effects of slope within orchards on flyspeck incidence for fungicide-treated (fng.) and non-treated (no fng.) blocks.

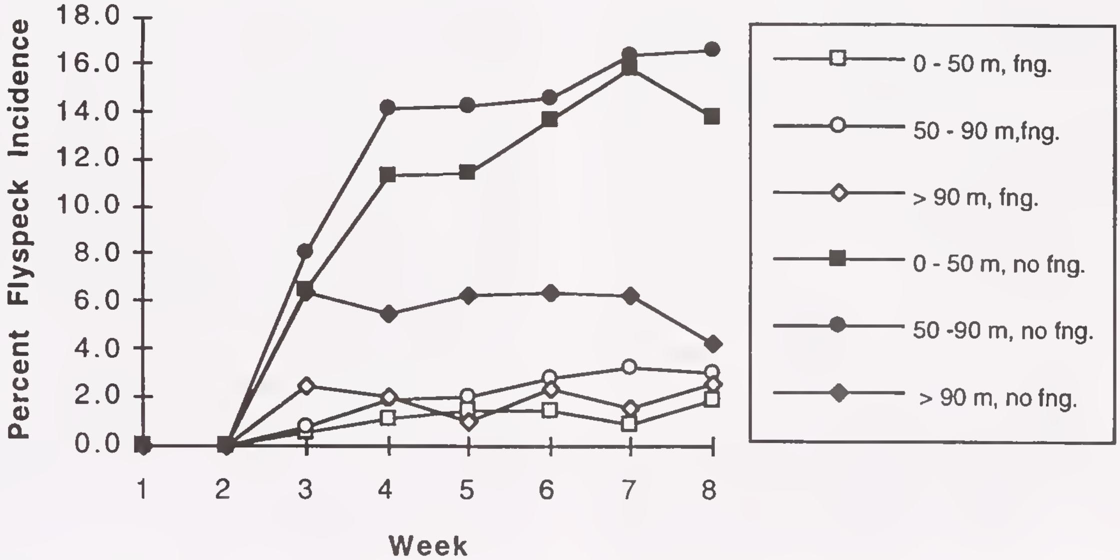

Figure 4. Effects of distance to inoculum in borders on flyspeck incidence for fungicide-treated (fng.) and non-treated (no fng.) trees.

blackberry cane density was slight.

The steeper the slope in a block, the less flyspeck incidence (Figure 3). This factor may be related to air drainage or air circulation. Applying fungicides erased the slope effect.

As hypothesized, the closer a block was to the border inoculum, the higher the flyspeck incidence (Figure 4). We also looked at this distance effect in a different set of plots. Cooperating growers also were asked to leave a strip of trees unsprayed during the summer. The strips extended from the borders of a blocks to the interiors over a distance of approximately 80 meters. At approximately weekly intervals from late July into September, trees in

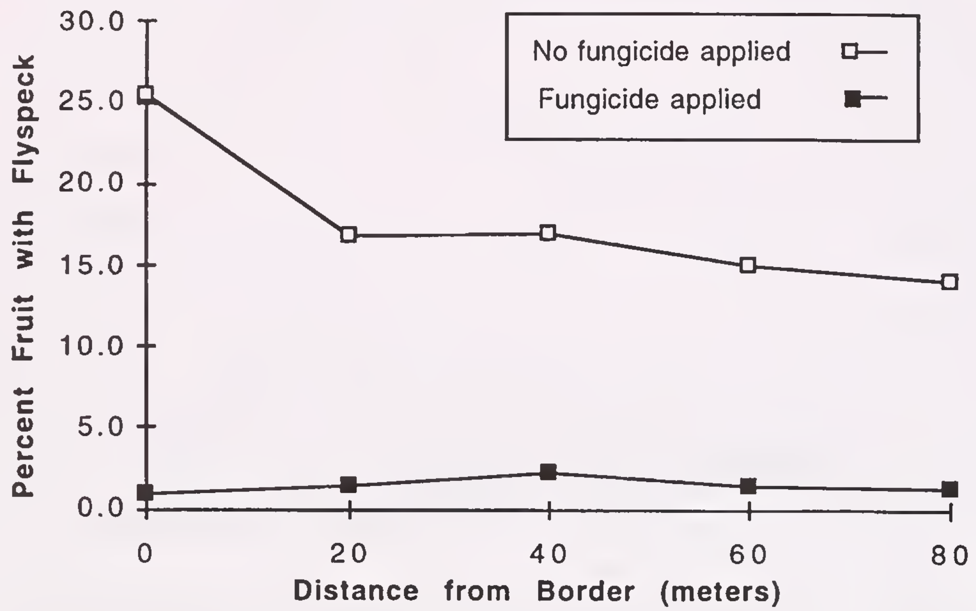

Figure 5. Effects of distance from the block border on flyspeck incidence in fungicide-sprayed and non-sprayed apples.

the swath were sampled for flyspeck. Sprayed trees at the same distances in the block were also sampled for flyspeck. Again, the closer the trees were to the border, the more flyspeck there was (Figure 5). Fungicide applications greatly decreased flyspeck incidence at any distance, largely removing the distance effect in all of the plots. In the strip plots without summer fungicides, flyspeck incidence dropped from 25% to 16% over the first 20 meters from the border. However, there was little decrease over the next 60 meters. Similarly, in the small plots from 0 up to 90 meters without fungicides, flyspeck incidence was relatively high, around 12 to 16%. However, in the plots beyond 90 meters from the border, flyspeck dropped to about 6%.

We know that in the absence of fungicides, flyspeck can vary dramatically, from barely existing in some blocks to infesting nearly one third of the fruit in another. In orchards where natural occurrence of flyspeck is very low, it is tempting to say that summer fungicides are not needed, or may be effective with only a single application. In this experiment, we saw that the combined factors (date, relative altitude of the block, slope, density of brambles in the border, canopy density, and distance from the border) could explain about 30% of the differences in flyspeck incidence we saw that in the no fungicide blocks. That means that some other, as yet unidentified, factors are having a major effect on flyspeck. If we can identify these factors, it will be possible to determine which blocks need normal summer fungicide treatments, and which may produce a high quality crop with few or no summer fungicides.

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Is There Benefit in Removing Drops to Prevent Within-orchard Buildup of Apple Maggot Flies?

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The apple maggot fly is a key summer pest of apples in eastern and midwestern regions of North America. Ever since the advent of synthetic organic insecticides, most orchardists have been able to achieve effective control of apple maggot by applying two to four insecticide sprays during July and August. Recently, we have developed a behavioral approach to apple maggot control for use in large commercial orchards. It involves surrounding an orchard block with odor-baited red spheres placed about five yards apart on perimeter apple trees. The intent is to intercept flies immigrating from nearby unmanaged host trees and thereby prevent them from penetrating into the orchard interior. Flies alighting on the spheres are killed either through entanglement in a coating of sticky material on the sphere surface or, using a new approach we have been developing, through ingestion of a feeding stimulant and insecticide on the sphere surface.

In a recent survey in Massachusetts [*Fruit Notes* 60(4):1-2], apple growers perceived several potential benefits arising from use of this behavioral approach to apple maggot management as a substitute for application of insecticide sprays. A potential shortcoming, however, is the danger that some flies will not be intercepted by the perimeter traps and will go on to oviposit within the orchard. Larvae developing within the flesh of infested apples could (following apple drop, larval exit, and puparial formation in the soil) give rise to adults emerging the next year within the confines of the orchard, thereby compromising the value of perimeter interception traps.

One way to counter the potential deleterious effect of within-orchard fly emergence would be to pick up dropped apples before larval exit (very rarely do larvae exit from fruit hanging on the trees). Indeed, picking up drops was considered to be the most effective way of controlling apple maggot before the advent of inorganic insecticides last century. Toward this end, several researchers earlier this century studied patterns of larval exit from drops of early, middle, and late-ripening apple cultivars with the aim of pinpointing frequency of need for drop pick-up to prevent larval exit. None of these early investigators, however, studied patterns of larval exit from drops of important modern-day apple cultivars.

Here, we report combined results of studies carried out in 1993 and 1994 of patterns of larval exit from drops of four prominent cultivars representing a range from early ripening (Jersey Mac) to middle (McIntosh and Cortland) and late ripening (Golden Delicious). Our primary intent was to determine whether, for each cultivar, there was a single point during the time period spanned by our study that a grower could pick up drops and thereby ensure that a great majority of larvae infesting total drops for the year would be removed before exiting the fruit.

Materials & Methods

Our study was conducted in a commercial orchard slightly infested by apple maggot flies. Infestation occurred as a consequence of suboptimal deployment of odor-baited red sphere traps, which permitted some proportion of flies to escape capture. Each year, ten trees of each cultivar were designated randomly for removal of drops. Ten drops per tree were removed on each sampling date and pooled to comprise a total sample of 100 drops for that cultivar on that date. To ensure that all drops removed on a given date had fallen only since the previous sampling date, we marked off a portion of the area beneath each of the ten sampled trees, and on each sampling date removed all drops that had fallen into that area. Sampling dates were about four weeks and two weeks before harvest, harvest, and two weeks after harvest. In every case,

Table 1. Of the total number of apple maggot larvae emerging from samples of drops removed beneath each cultivar at bi-weekly intervals from four weeks before harvest until two weeks after harvest in 1993 and 1994, the number of larva that could have been prevented from emerging by picking up drops at indicated times.

Cultivar	Total number of emerging larvae	Emerging larvae prevented by picking up drops (% of total)			
		Four weeks before harvest	Two weeks before harvest	At harvest	Two weeks after harvest
Jersey Mac	159	9	43	38	10
McIntosh	82	21	49	29	1
Cortland	49	18	52	28	2
Golden Delicious	100	26	48	20	6

enough fruit remained on the trees following harvest to provide a two-week postharvest sample.

Each batch of 100 sampled drops was placed on the ground beneath the canopy of a large non-bearing apple tree. Weekly, beginning on the day of acquisition, each batch of drops was examined carefully for evidence of larval exit holes. An exit hole has a characteristic appearance of torn apple skin surrounding the hole. To confirm that an apparent exit hole was in fact an exit hole, we cut the flesh beneath the skin and examined it for evidence of characteristic larval trails. All suspected exit holes were confirmed, following which apples containing an exit hole were removed from the batch.

Results

Data in Table 1 show percentages of larval exit holes that could have been prevented by picking up drops at various intervals before, during, and after harvest. The pattern is similar for each cultivar. Peak larval exit occurred about two weeks before harvest. Only 1 to 10% of larval exit holes occurred two weeks after harvest.

Values in Table 2 represent, for each cultivar, estimated percentages of the total number of fruit which dropped that fell before or at harvest. For purposes of this table, we assumed complete harvest of all fruit on the tree at harvest time and hence no new drops after harvest. Our estimates are that 35 to 40% of all drops up to and including harvest fell between four and two weeks before harvest, with 45 to 60% falling between two weeks before harvest and at harvest.

Values in Table 3 represent for each cultivar at each interval before or at harvest, an estimate of the proportion of all larval exit holes that could have been prevented by picking up all drops at intervals before or at harvest. These values indicate that the most effective time to pick up Jersey Mac drops would be at harvest whereas the most effective time to pick up drops of McIntosh, Cortland and Golden Delicious would be about two weeks before harvest. Even at the optimum drop removal time for each cultivar, 40to 50% of larvae would have escaped re-

Table 2. Of the total number of fruit beneath each cultivar that dropped up to and including harvest, estimated percentages that dropped between the previous and the designated time interval.*

Cultivar	Estimated drop (% of total drop)		
	Four weeks before harvest	Two weeks before harvest	At harvest
Jersey Mac	5	35	60
McIntosh	15	35	50
Cortland	15	40	45
Golden Delicious	15	35	50

*For purposes of this table, we assumed complete harvest of all fruit on the tree at harvest time.

Table 3. For each cultivar at each interval before or at harvest, estimated percentages of all emerging larvae that could have been prevented by picking up all drops at designated times.*

Cultivar	Estimated emerging larvae prevented by picking up all drops (%)		
	Four weeks before harvest	Two weeks before harvest	At harvest
Jersey Mac	1	39	60
McIntosh	9	50	41
Cortland	7	58	35
Golden Delicious	13	55	32

*Each vallue here was derived from (a) multiplication of values given in Tables 1 and 2 for that cultivar at that time interval, (b) addition of all multiplied values for that cultivar, (c) setting "b" equivalent to 100%, and (d) calculating the value given here for each time interval as a percentage of "c".

moval either by having already exited dropped fruit before pick up or by being present in infested fruit still hanging on the tree (these fruit would eventually drop, but after the optimum drop removal time).

Conclusions

Results of our two-year study indicate foremost that little is to be gained in terms of preventing within-orchard buildup of apple maggot flies by picking up drops two weeks after harvest. By that time, larval exit from drops is nearly complete. For cultivars such as Jersey Mac that ripen in August, drop removal would be most effective at harvest. For mid-ripening cultivars such as McIntosh and Cortland, drop removal would be most effective about two weeks before harvest. The same would be true for later cultivars such as Golden Delicious.

Even at the most effective time of drop removal for each cultivar, however, only about half of apple maggot larvae infesting that cultivar would be removed. The remainder could exit fallen fruit and form puparia in the soil. Therefore, we seriously doubt that the modest gain in terms of preventing within-orchard apple maggot buildup would justify the extra cost of labor to remove drops specifically for that purpose. Hence, for the future, we plan to place increased emphasis upon optimizing patterns of odor-baited red sphere trap deployment for controlling the adults to preclude the need for removing drops.

Acknowledgments

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Rootstock Affects Ripening of McIntosh Apples

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Monitoring and controlling ripening is an important aspect of orchard management. Several factors affect ripening of any particular cultivar of apple, such as climate, strain, chemical treatments, and crop load. Cultivars may vary in their response to these factors. As an example of this variation, work conducted at the Horticultural Research Center a few years ago compared the effects of crop load on ripening of Delicious and Golden Delicious apples. Golden Delicious ripening was ten days later for heavily cropping trees compared to lightly cropping trees; whereas, Delicious at similar cropping levels were different by only four days.

Previously, I reported that rootstock affected Delicious apple ripening [*Fruit Notes* 56 (2):8-9 and 56(3):3-5]. Specifically in the 1980 NC-140 Planting, O.3 and M.27 EMLA advanced ripening, and M.27 EMLA and OAR1 delayed ripening. In the 1984 NC-140 Planting, C.6, B.9, and M.26 EMLA advanced ripening of Delicious fruit. It is conceivable that rootstock effects on ripening may vary from cultivar to cultivar.

The study reported here was initiated to examine the effects of rootstock on McIntosh ripening. Summerland Red McIntosh trees on M.9/A.2, O.3, M.7 EMLA, M.26 EMLA, M.7A, OAR1, and Mark were planted in 1985 in a trial at the University of Massachusetts Horticultural Research Center (Belchertown) with seven replications. Tree size and productivity were reported in *Fruit Notes* 60(1):8-11. To assess ripening differences, internal ethylene concentrations in fruit were measured periodically each harvest seasons from 1988 through 1994. Further, fruit were sampled once per year for the measurement of flesh firmness, soluble solids concentration, and starch index value from 1990 through 1994.

At the beginning of ripening, fruit become capable of producing large quantities of ethylene, and internal concentrations rise dramatically through the process of ripening. In this study, internal ethylene concentrations were affected significantly by rootstock (Table 1). Some variation occurred from year to year, but overall, O.3 and M.26 EMLA consistently resulted in ethylene levels higher than those of other rootstocks. Fruit from trees on OAR1,

Table 1. Effects of rootstock on McIntosh ripening.[z]

Rootstock	Internal ethylene (ppm)	Date when internal ethylene = 1ppm (September)	Soluble solids (%)	Starch index[y]	Flesh firmness (lbs)[x]
M.9/A.2	0.7 b	21.6 a	11.2 c	4.7 b	15.2 a
O.3	1.2 a	19.3 b	11.7 a	5.1 a	15.3 a
M.7 EMLA	0.7 b	21.2 a	11.4 bc	4.6 b	15.1 a
M.26 EMLA	1.3 a	19.3 b	11.7 a	5.1 a	15.0 a
M.7A	0.7 b	21.8 a	11.3 c	4.6 b	15.3 a
OAR1	0.5 b	22.2 a	11.4 bc	4.6 b	15.7 a
Mark	0.8 b	21.1 ab	11.6 ab	5.2 a	15.4 a

[z]Means within columns not followed by the same letter are significantly different at odds of 19:1.
[y]Starch index: 1=very immature, 9=very ripe.
[x]Values adjusted for fruit size differences.

M.7 EMLA, and M.7A were most consistently in the lowest category. Average internal concentrations of ethylene, however, provide only a static look at differences. It is acceptable to assume that fruit with higher levels of ethylene are in fact riper, but it is not clear how much riper.

Plotting the rise in ethylene concentration over time allows for direct comparison of the timing of ripening. The rise up to one ppm is relatively slow; however, ethylene concentrations increases rapidly after they reach one ppm. Therefore, a simple benchmark parameter to compare timing is when the internal ethylene concentrations reaches one ppm. Table 1 gives the averages from this experiment. Generally, these data confirm the differences found with overall ethylene concentrations, i.e. fruit from trees on O.3 and M.26 EMLA ripened earlier than fruit from trees on other rootstocks (with the exception of Mark, which was intermediate). The difference between the earliest and the latest to ripen was on average about three days. This difference is very small; however, the magnitude varied from year to year and ranged up to as many as six days.

The timing of ripening varies to a significant degree from fruit to fruit. Therefore, a degree of uncertainty exists about any assessment of ripening, even one as accurate as internal ethylene measurement. To reduce this uncertainty, it is important to measure other factors that change with ripening. As apples ripen, starch is broken down into sugar. So, during ripening, sugar (soluble solids) concentrations increase and starch concentrations decrease, giving two additional assessments of ripening. Table 1 shows both the soluble solids concentrations and starch index values of fruit from trees on these rootstocks. Generally, fruit from trees on O.3 and M.26 EMLA had relatively high sugar concentrations and starch index values (low amounts of starch), suggesting that these fruit were riper at harvest than fruit from trees on most of the other rootstocks. Both measurements confirm the results from the ethylene measurements.

Overall, these data suggest that O.3 and M.26 EMLA advance ripening and that M.9/A.2, M.7 EMLA, M.7A, and OAR1 delay ripening. Mark is less consistent in its effect. These results support those with Delicious as the scion cultivar; however, the magnitude of the differences were not as great for McIntosh as for Delicious.

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Progress in 1995 Toward Development of Toxicant-treated Spheres for Controlling Apple Maggot Flies

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Previous *Fruit Notes* have addressed the potential of using toxicant-treated spheres for controlling apple maggot flies. Our ideal toxicant-treated sphere would be one that 1) employs only a small amount of safe toxicant, 2) encourages an alighting fly to feed voraciously upon arrival and thereby to ingest the toxicant, 3) possesses at least 12 weeks of effective residual activity, and 4) is safe to handle and deploy.

Here, we report on results of comparisons between the 1994 version of toxicant-treated sphere and three of the most promising sphere prototypes developed during 1995. Specifically, we present information on sphere composition, degree of toxicity to maggot flies before and after varying amounts of rainfall, and safety of spheres for handling and deployment.

Materials & Methods

All spheres reported on here were wooden, 3 inches in diameter, and coated by brush with one or more layers of liquid material. Compositions of coating were as follows:

Type A. 1994 version, consisting of a single layer of a mixture containing 2% Digon 4E (1.0% dimethoate as the active toxic ingredient), 40% Glidden gloss red latex paint, and 58% granulated table sugar (sucrose).
Type B. Two layers of mixture. First layer consisted of 20% Glidden flat red latex paint, 76% granulated table sugar, and 4% wheat flour. Second layer consisted of 1% Digon 4E and 99% of the same paint.
Type C. Three layers of mixture. First two layers were same as for Type B. Third layer was linseed oil.
Type D. Three layers of mixture. First two layers were same as Type B. Third layer was shellac.

In all cases, spheres were allowed to dry (usually 1-2 days) between applications of layers and before deployment. In some cases, a small amount of water was added to the final mixture of the first and second layers to facilitate brushing.

To assess toxicity of each type of sphere to apple maggot flies, 12 spheres of each type were hung from branches of apple trees at the University of Massachusetts Horticultural Research Center (Belchertown) in early July. After 0, 1, 3, 5, 7, and 10 weeks, two spheres of each type were brought to the laboratory for toxicity assays. Thirty flies were released individually onto each sphere (total of 60 per sphere type) and allowed to remain there up to ten minutes. After exposure, each fly was kept in a small cup for 24 hours to assess mortality. Flies originated frompupae collected from nature, emerged in laboratory cages, were 12 to 15 days old when tested, and were starved of all food 10 to 15 hours prior to testing.

To determine the effect of rainfall on loss of fly feeding stimulant (sucrose), separate sets of spheres of each type were hung in a laboratory chamber that delivered artificial rainfall at a rate of one inch per hour. This was done for one hour per day over seven successive days, with 23 hours of drying time between rainfall exposure events. Runoff from each sphere was collected and submitted to chemical analysis for percent sucrose content.

Finally, we compared the safety of handling dimethoate-treated spheres with the safety of handling apple foliage and fruit treated with a spray of dimethoate. In early August, several apple trees at the Horticultural Research Center received a spray of Digon 4E applied by air blast sprayer at the equivalent of 300 gallons water per acre. The amount of Digon 4E used was 16 ounces per 100 gallons water, which is the label-recommended rate for control of apple maggot flies. Immediately following spraying, we hung several freshly-prepared Type B pesticide-treated spheres on adjacent apple trees. At designated intervals after spraying,

sprayed foliage and fruit along with two spheres were brought to the laboratory for determination of surface dislodgeable residues of dimethoate (i.e. residues that would be available to individuals that came into contact with foliage, fruit or sphere). Residues were removed from samples of apples and from spheres by thoroughly wiping twice the fruit or sphere surface with a piece of cheese cloth moistened with water. This is standard toxicological methodology for removing surface residues. A slightly different (but also standard) approach was used for removing surface residues from samples of sprayed foliage (owing to potential tearing of leaf surfaces by wiping with cheesecloth). Precise amounts of dimethoate residues in each sample were determined by standard pesticide analytical methodology.

Results

All four types of sphere caused mortality to 100% of alighting apple maggot flies when tested on the first day of deployment, before any rain fell. After five weeks and 3.45 inches of cumulative rainfall, mortality fell to 0% for Type A spheres (1994 version single-layer spheres) but remained at a substantial level for the other types of spheres: 43% for Type B (two layers), 50% for Type C (three layers, linseed oil as third layer), and 70% for Type D (three layers, shellac as third layer) (Figure 1). After ten weeks and 6.4 inches of cumulative rainfall, mortality fell to 0% for Type B spheres, 10% for Type C spheres, and 30% for Type D spheres. When a 20% sucrose, 80% water mixture was applied to each sphere at ten weeks, mortality was restored to a level of 70-75% for each sphere type. This result suggested that the principal reason for decline in effectiveness of each sphere type over time was loss of feeding stimulant and, to a much lesser extent loss, of toxicant.

This suggestion was confirmed in assays of spheres exposed to artificial rainfall. As shown in Figure 2, Type A spheres lost 100% of sucrose after one inch of rainfall, whereas 100% loss of sucrose did not occur in Type B and Type C spheres until four and six inches of rainfall, respectively. Even after seven inches of rainfall, Type D spheres retained 30% of original sucrose. Unfortunately, the third layer of mixture (shellac) that conferred this greater retention of sugar in Type D spheres some-

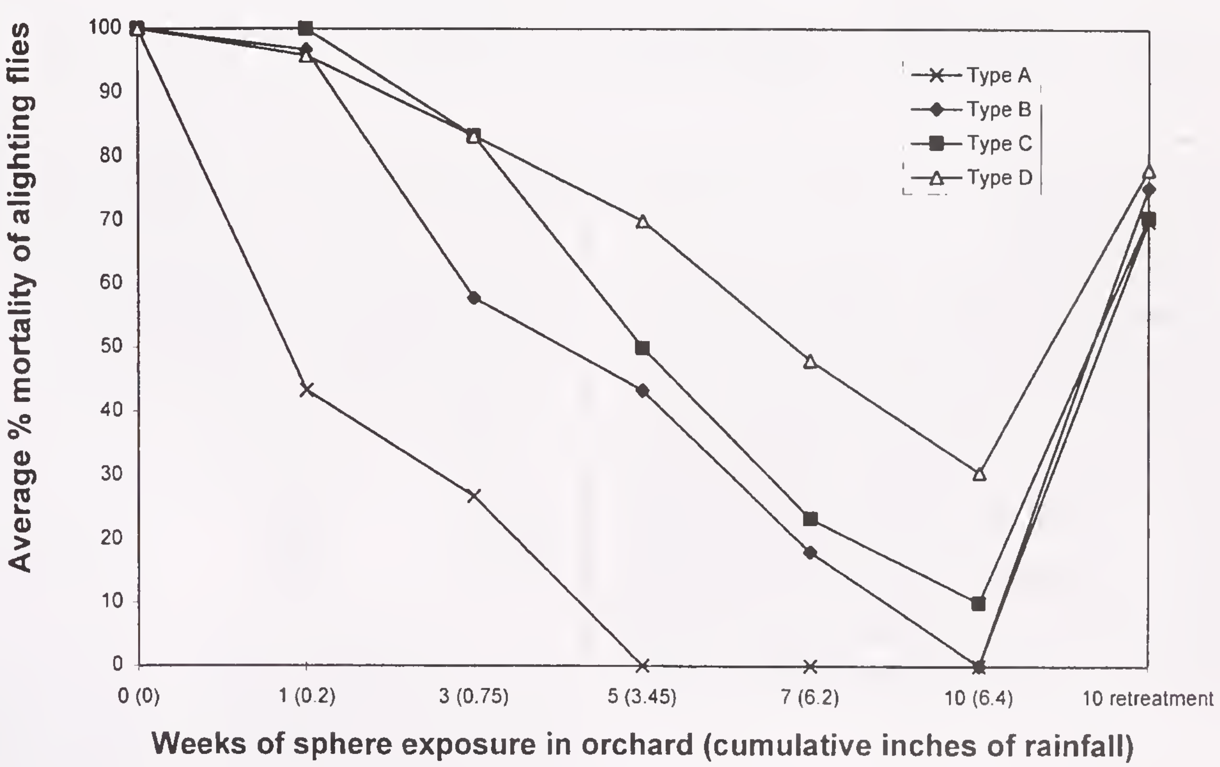

Figure 1. Residual activity of four types of dimethoate-treated spheres for controlling apple maggot flies.

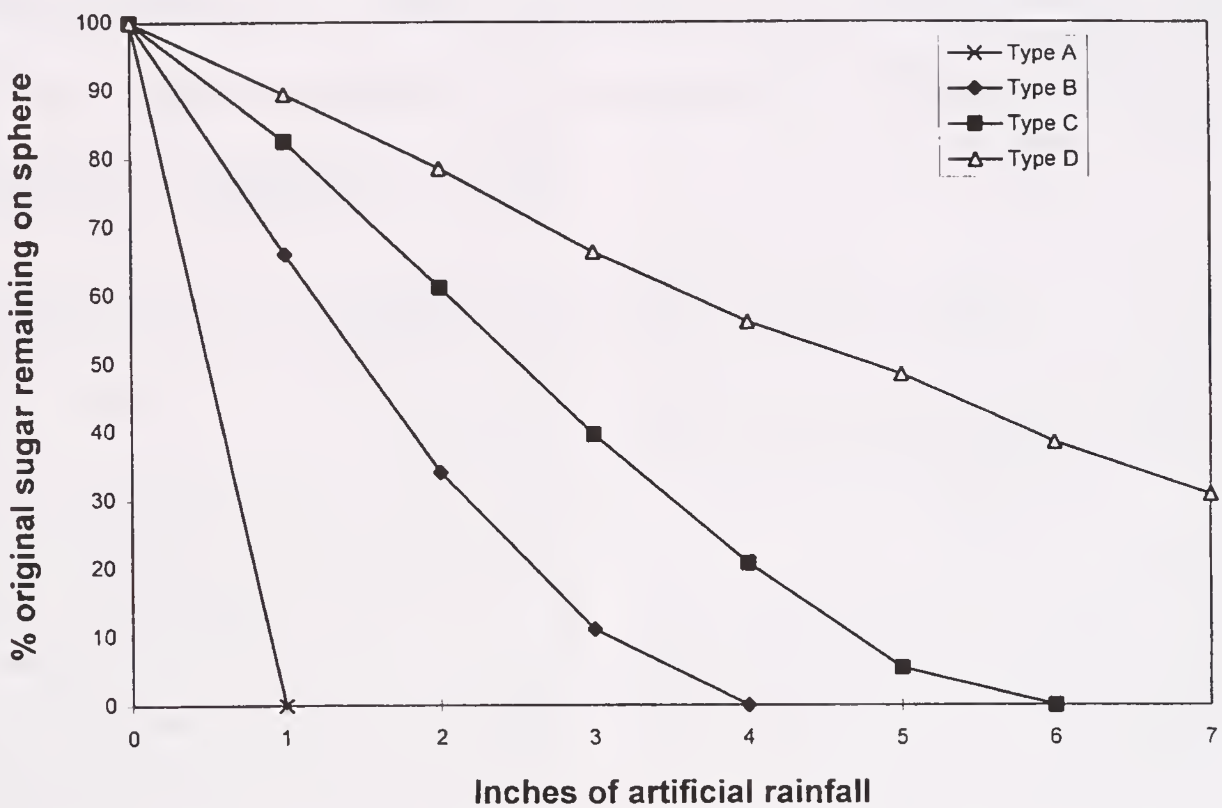

Figure 2. Percent of original sugar remaining on four different types of spheres following exposure to artificial rainfal.

times caused the spheres to turn whitish under high humidity conditions.

The average amount of dimethoate residue on the surface of toxicant-treated spheres (Type B) 48 hours after sphere deployment was only about one-fifth the amount on the surface of apple foliage sprayed with dimethoate 48 hours earlier (Table 1). At 48 hours, essentially no residue was present on the surface of apple fruit. Apparently the dimethoate had been absorbed by the fruit flesh, which is a property of dimethoate that confers its well-known long-residual systemic activity to insect larvae feeding on fruit flesh. Even after one month of field exposure, during which 2.8 inches of rain fell, the amount of dimethoate on the surface of apple foliage and Type B spheres remained at nearly the same levels as at 48 hours.

Table 1. Average amount of surface dislodgeable residue of dimethoate (g/cm^2 of surface area) on apple foliage, apple fruit, and Type B spheres at different times following spraying of trees with dimethoate or deployment of freshly-prepared spheres.

Structure	48 hours	30 days
Foliage	1.04	1.10
Fruit	0.01	0.00
Spheres	0.20	0.15

Conclusions

The most effective toxicant-treated wooden sphere developed through our 1995 research efforts represents a substantial improvement over our 1994 version. This was accomplished mainly by applying three layers of mixture to the sphere surface to create better retention of sugar (fly feeding stimulant) present in the first layer. For deployment for apple maggot fly control in orchards, we would like

to see at least 70% kill of all flies that alight on a sphere. This is the approximate level of kill currently provided by sticky-coated red wooden spheres one week afterdeployment. Sticky-coated spheres require frequent cleaning to maintain this level of kill. Type D spheres received a third-layer coating, consisting of shellac, that provided 70% kill of alighting flies five weeks after deployment, during which slightly more than three inches of rain fell.

We consider this to be an important step forward in the development of toxicant-treated spheres. Still, there remains much research to be done to achieve our goal of 12 weeks of high residual activity. For example, there are two principal shortcomings to current Type D spheres. First, for every rain event of one-fourth inch or greater after about 3 inches of rainfall, type D spheres require retreating with a sugar-water mixture to replenish at least some of the lost fly-feeding stimulant. Second, the sphere surface may turn whitish after exposure to high humidity, dew, or rainfall on account of the moisture-absorbing properties of shellac. This reduces visual attractiveness of the spheres to the flies.

Even with these shortcomings, however, we are encouraged to seek improvements not only because of progress made in 1995 but also on account of the safety of current spheres to those deploying or handling spheres in an orchard. Indeed, the toxicological date revealed that it is much safer to repeatedly touch the surface of a dimethoate-treated sphere (as currently formulated) than to repeatedly touch the surface of apple foliage sprayed with a standard rate of dimethoate for maggot fly control at a legally approved orchard-reentry time of 48 hours after spraying.

Acknowledgments

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Effects of Apollo Alone and in Combination with Dormant Oil on European Red Mite Populations in a Commercial Apple Orchard

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European red mites (ERM) are the most significant foliar pests in many apple orchards throughout New England. Excessive feeding by ERM populations can severely damage the photosynthetic capability of the tree resulting in a reduction in fruit size and premature fruit drop.

Effective ERM control is often difficult to achieve. Several predatory mite species have been identified in our region; however, these beneficials rarely build to levels sufficient to impact ERM populations before significant damage occurs. Chemical control is not only costly but is often ineffective. The standard materials used for mite control on apples have been registered for quite some time and various degrees of tolerance are suspected.

In 1995, AgrEvo received federal registration for use of Apollo on apples. Apollo is the first new acaricide to be registered on apples in recent history and it belongs to a different class of materials with a unique mode of action compared to commonly used miticides. Apollo is primarily an ovicide. It is effective in preventing hatch when mite eggs come in contact with the material but it has little or no effect on adult mites. Apollo is also unique in that the federal label restricts its use to prebloom applications only.

The backbone of most mite-control programs in New England consists of at least one, if not two, dormant oil applications prior to ERM egg hatch. Subsequent applications of summer miticides are made as needed to suppress ERM populations below problem levels. Given the label restriction pertaining to prebloom use, how would Apollo fit into our program? Would it replace one of the oil treatments? Would we need to use oil at all if Apollo is such an effective ovicide? Would it be best used in combination with oil?

The following trial was initiated in the spring of 1995 in an attempt to answer these questions. A five-acre block of McIntosh and Delicious trees in a commercial orchard owned and operated by Fairview Orchards, Ayer, MA. was selected and divided into five plots. This block had a history of high ERM pressure (two or three summer miticides) and visual inspection revealed that a relatively uniform distribution of overwintering eggs was present. Each plot consisted of two rows of Delicious trees bordered by a row of McIntosh trees on each side. Trees were approximately 14 feet tall, planted on a 16 x 22 feet spacing, with a dilute tree row volume of 267 gallons per acre.

Treatments were applied to adjacent, non-replicated plots with an airblast sprayer calibrated for a total output of either 300 gallons per acre (1/4" green) or 150 gallons per acre (tight cluster) while

Table 1. Materials, dates, and application rates for five treatments in the Apollo trial, 1995.

4/21 (1/4-inch green)[z]	5/1 (tight cluster)[y]
no trt	Apollo
oil	oil
oil	Apollo
oil	oil + Apollo
no trt	no trt

[Z]Application rate on 4/21 was 2 gal superior oil per 100 gal, delivered at 300 gal per acre.
[Y]Application rate on 5/1 was 1 gal superior oil **and/or** 1.33 oz Apollo per 100 gal, delivered at 150 gal per acre.

operating at 2.5 miles per hour. Treatments consisted of either a single application at tight cluster or two applications in various combinations of oil and Apollo at 1/4-inch green and tight cluster. Materials were applied as outlined in Table 1 under calm conditions.

European red mite populations were evaluated periodically by selecting 15 leaves per tree randomly from each of four trees per treatment. Composite samples then were brushed on to glass plates, and mite populations were estimated using standard leaf brushing protocol. Results were recorded as motile forms per leaf.

Results & Discussion

As would be expected, all four treatments suppressed early season ERM buildup when compared to the check (Figure 1). Mite populations increased rapidly where no prebloom treatments were applied so that intervention with summer miticides was warranted by late June. Data collection was discontinued once mite populations exceeded threshold levels and "rescue" treatments were deemed necessary.

The split treatment of oil alone and the Apollo treatment at tight cluster provided similar results. Both these treatments effectively controlled ERM populations until approximately mid July. The relatively high counts recorded on July 20 consisted mostly of recently hatched nymphs that did not result in excessive foliar damage before a contact miticide could be applied. These results are consistent with the effect observed most years when growers apply the two-oil-spray program. The single application of Apollo at tight cluster was able to duplicate these results.

The most effective ERM suppression observed in this trial was noted in the oil followed by Apollo plot and the oil followed by oil plus Apollo plots. Little difference was noted between these two plots. Both of these regimes were able to keep red mite populations below troublesome levels for the entire growing season. ERM counts averaged approximately 6 per leaf in late August so that no summer contact miticides were necessary. Foliar condition was excellent in both plots, with only minimal bronzing of fruit spurs low and inside the tree canopy.

Conclusions

While it is difficult to draw firm conclusions from a single non-replicated study in any given year, the data presented here suggest that the inclusion of

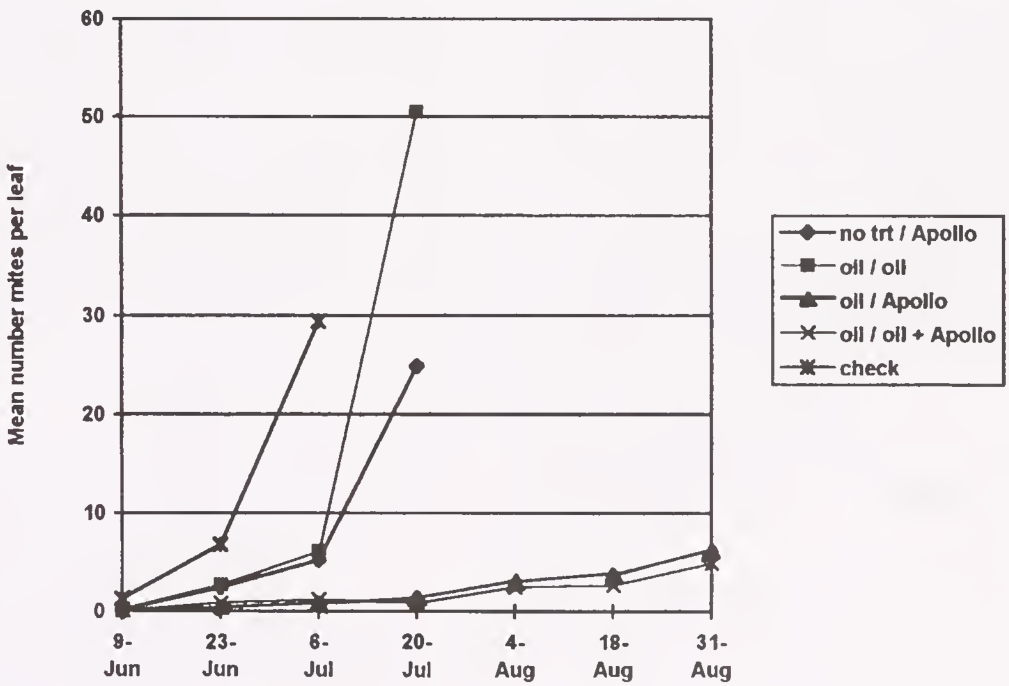

Figure 1. Effects of Apollo alone and in combination with dormant oil on European red mite populations.

dormant oil in our early season mite-control programs may be advisable compared to the use of Apollo alone. Treatments combining oil plus Apollo provided the greatest degree of ERM suppression in this trial. The most cost effective approach, however, may be to apply oil at 1/4-inch green followed by Apollo alone around tight cluster since no additional benefit was noted from including oil again in the second application.

Continuing the use of dormant oil would also be consistent with a prudent resistance management program. Researchers in Canada, where Apollo has been registered since 1989, already suspect tolerance to the material despite the limitation to only one prebloom application per season. Taking pressure off the Apollo treatment by reducing the number of viable eggs present at the tight cluster stage may ultimately extend the effective lifetime of this material.

More work is necessary to determine the best approach to utilizing this new material in a commercial orchard setting. We intend to continue this study in 1996 in order to broaden this database and to look more closely at the potential interaction between dormant oil and this new class of ovicidal miticides.

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Effects of Calcium Salts on Flyspeck and Sooty Blotch of Golden Delicious Apples

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Apple producers in the northeastern United States frequently apply calcium chloride ($CaCl_2$) to apples as summer sprays in order to improve fruit storability. These sprays need to be applied several times from July to harvest for optimal effects, and may be combined with fungicides to control summer diseases, particularly flyspeck and sooty blotch. The incidences of these diseases vary from year to year, and they may require minimal controls one season, but significant efforts in another.

The effects of calcium chloride on flyspeck and sooty blotch have not been examined. Other cation salts, notably sodium bicarbonate, have been effective in controlling powdery mildew on some plants; therefore, it would be worthwhile to evaluate the extent of the effects of calcium chloride and related cation salts on sooty blotch and flyspeck.

This experiment was designed to evaluate the effects of calcium chloride, calcium nitrate ($CaNO_3$), and potassium carbonate (KCO_3) on the incidence of flyspeck and sooty blotch on apple fruit. The cation salts in combination with a commercial wetting adjuvant (Latron B1956) were applied at 2-week intervals starting in mid-July, and were compared to a standard fungicide treatment (Benlate plus captan) applied at a 3-week intervals and to non-treated controls. All sprays were applied at 6X with an air blast sprayer. Trees were mature Golden Delicious/M.7, located in four rows at the University of Massachusetts Horticultural Research Center, Belchertown. Each treatment was applied to 3-tree plots, and was replicated 5 times. The treatments with rates are listed in Table 1.

On 16 October, seventy fruit from the center tree of each plot were harvested randomly, and the presence or absence of flyspeck or sooty blotch was recorded. Ten apples were selected at random from each sample and weighed. The flesh firmness of these 10 apples was measured (2 readings per apple). Four plugs were taken from each apple and frozen for later calcium determination. The remaining apples were kept at 32°F. For calcium determination, plugs were dried and ashed, and then samples were analyzed using atomic absorption spectrophotometry.

On 26 February 1996, samples were removed from cold storage, and the firmness of 10 apples per

Table 1. List of treatments applied to Golden Delicious apples from mid-July to harvest, 1995.

Treatment	Amount/100 gal	Timing interval (wks)
Captan 50WP + Benlate 50WP	1 lb. + 6 oz.	3
$CaCl_2$ + Latron B1956+vinegar	3.3 lb +3 fl.oz+2.2 fl.oz	2
$CaNO_3$ + Latron B1956	5.3 lb +3 fl.oz	2
$CaCl_2$ + $CaNO_3$ + Latron B1956+ vinegar	2.5 lb +4.0 lb+3 fl.oz+2.2 fl.oz	2
KCO_3 + Latron B1956	3.0 lb + 3 fl.oz	2
Latron B1956	3 fl. oz.	2
Control (no spray)	none	—

sample was measured. Samples were kept for 13 days at 70°F, after which the incidences of decay, bitter pit, cork spot, and senescent breakdown were determined.

Treatment with fungicides provided significantly better control of both flyspeck and sooty blotch than any of the other treatments (Table 2). Calcium nitrate, calcium chloride, and potassium carbonate, however, all reduced the incidence of these two diseases compared to controls. Treatments did not affect the calcium concentration of fruit, nor did they affect the incidences of storage disorders (data not shown). Flesh firmness was altered by treatment, both at harvest and after storage (Table 3); however, the differences were relatively small and were not consistent with previously observed responses.

The results from this study were not outstanding. Still, they open the intriguing possibility that calcium nitrate or calcium chloride might be used in conjunction with relatively low rates of a fungicide to achieve acceptable control of flyspeck and sooty blotch. Our research this summer will examine fungicide interactions with these cation salts to determine whether or not fungicide rates may be reduced.

Table 2. Percent of fruit infected with flyspeck or sooty blotch.*

Treatment	Flyspeck (%)	Sooty blotch (%)
Captan 50WP + Benlate 50WP	4 d	2 d
$CaNO_3$ + Latron B1956	40 c	21 c
$CaCl_2$ + Latron B1956+vinegar	52 c	38 b
KCO_3 + Latron B1956	54 bc	36 b
$CaCl_2$ + $CaNO_3$ + Latron B1956	60 ab	34 b
Latron B1956	60 ab	51 a
Control	70 a	60 a

*Means within columns not followed by the same letter are significantly different at odds of 19 to 1.

Table 3. Flesh firmness (lbs) at harvest and after storage of Golden Delicious apples.*

Treatment	At harvest	After storage
CaNO3 + Latron B1956	14.6 c	10.3 ab
Control	14.7 c	9.9 c
KCO_3 + Latron B1956	15.0 bc	10.2 ab
$CaCl_2$ + Latron B1956+vinegar	15.2 ab	10.4 a
Latron B1956	15.3 ab	9.8 c
$CaCl_2$ + CaNO3 + Latron B1956	15.4 ab	10.0 bc
Captan 50WP + Benlate 50WP	15.6 a	10.0 bc

*Means within columns not followed by the same letter are significantly different at odds of 19 to 1.

* * * * *

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1995 Tree-fruit Survey

William M. Coli, Roberta Szala, Wesley R. Autio, Daniel R. Cooley, Karen I. Hauschild, and Ronald J. Prokopy
University of Massachusetts

In the late winter/early spring of 1995, the Extension Tree-fruit Team sent out an extensive survey to 210 Massachusetts tree-fruit growers. Although an attempt was made to survey only commercial-scale growers, results later revealed that a sizable number of responses were received from individuals managing very small fruit plantings.

The principal purpose of the survey was to assess growers' opinions of the Tree-fruit research and extension program focus and delivery methods, and to determine if growers sought changes either in methods of delivery or in specific subjects covered. An additional purpose was to understand better the nature and extent of Massachusetts fruit grower adoption of integrated pest management (IPM). This latter purpose is compatible with expectations of the USDA as part of the National IPM Initiative, a nationally-coordinated attempt to secure increases in Federal funding for research and extension outreach related to pest management, including the development of biologically-based practices, and other alternatives to pesticide use. A key element of the National IPM Initiative, is that growers and other key stakeholders play an active role in the development of priority research, extension, and training needs which must be addressed if enhanced, voluntary IPM adoption is to occur in important production systems. In this and other articles, we will summarize the specific results of this survey.

The Survey Itself

Based on previous experience in our group, we chose to use the *Dillman Total Design Method of Mail and Telephone Surveys* as the survey method. By now, I suspect that most readers have received other Dillman-type surveys on other subjects. Dillman-method surveys are popular because they typically generate very high response rates. Without going into all the details of the method, two key elements are worth mentioning: a carefully-designed cover letter, and frequent follow-up mailings.

If you are like us, you probably have received the sort of survey which asks you to send in some sort of information *because it is useful to the person sending the survey*. Based on careful research, Dillman determined that one would get a far better response if the cover letter convinced the reader that they should complete the survey *because it was useful to members of some group to which the responder belonged (e.g., Massachusetts commercial fruit growers).* In addition to the design of any cover letters, another characteristic of a Dillman survey is the use of follow-up mailings. Most of us have received surveys which, as busy individuals, we put on a pile that we will deal with "later". Unfortunately for the surveyor, later often never comes. Again based on his research, Dillman determined that response rate increased with a post card reminder sent to all recipients one week after the initial mailing. An additional mailing to current non-respondents three weeks after the initial, including a slightly more urgent cover letter and another copy of the survey, and a similar follow-up at seven weeks also increase response rate.

Partly due to the method used, and certainly due to the time so many of you took to complete the questionnaire, the survey described here benefited from an outstanding response rate of 75% (158 completed surveys out of 210 sent). A response rate of this size is considered necessary if the investigator is to have confidence that s/he is accurately portraying the opinions of the *entire population sampled* (i.e. all Massachusetts commercial fruit growers), rather than simply a small, and potentially unrepresentative, subset. The Tree-fruit Team extends its sincere thanks to all respondents. Your help in completing this survey hopefully will enable us to target better the key research and extension needs you have identified.

How the Survey Data Were Handled

As surveys were received, responses to each question, and demographic data about the respondent and the farm itself were entered electronically into a database. After data were checked for entry errors, responses from each individual survey were sorted into four size categories according to the total acreage in tree fruits: Very Small (i.e., less than

5 acres), Small (i.e., 5.1 to 20 acres), Medium (i.e., 20.1 to 50 acres), and Large (i.e., over 50 acres). A fifth category summarizing responses for all respondents across all farm sizes was also included. Although most questions allowed choices from a list of possible options, some questions asked for a ranking of importance (e.g., "1. On a scale of 1 to 5, rank the topics listed below according to their importance to your orchard management, with 1 meaning most important, and 5 meaning least important."). In order to summarize results, the appropriate number was entered (1-5) for each survey, and an average ranking was calculated for that topic or item. Average score received by each choice then allowed us to compare the relative importance of each topic presented as possible answers to that question. For example, an item with a final average score of 1.5 was deemed more important by respondents that an item with a final score of 3.2

Responses to General Questions

To illustrate the just-described process, consider Question 1 (On a scale of 1-5, with 1 = Most Important, and 5 = Least Important, please rank the topics listed below in terms of their importance to your orchard management). Ranking of summarized responses for the category "All Growers" indicated that fruit growers appeared to assign greatest importance to the topic of "insect pest management", followed by "disease pest management", "horticulture", "other", "educating farmers in marketing", and "educating consumers about agriculture". However, within size categories, large growers assigned most importance to the topic of "horticulture", small and medium growers felt that "insect pest management" was most important, while very small growers assigned their top ranking to the topic of "disease pest management".

Similar differences in perceived importance were seen in Question 2, which asked growers to choose areas which they would like the Tree Fruit Team to focus on either more, less, or the same relative to current efforts. In the All Growers category, "insect pest management", "disease pest management" and "horticulture" were ranked 1, 2, 3 respectively. However, while "disease pest management" was ranked number 1 by very small and small growers, medium and large growers indicated that they would prefer the team focus more on "horticulture" than on the other choices.

For Question 3, which asked respondents to suggest which topics the team should de-emphasize in order to focus more on other areas, all farm-size categories were in agreement that we could de-emphasize "educating farmers in marketing" compared with all other choices. Although initially surprising to us, this result is consistent with responses to the previous question which assigned a relatively low importance to "educating farmers about marketing." Apparently, Massachusetts fruit growers feel that their marketing challenges are better left to their own devices, and would prefer we emphasize the production and protection of fruit crops.

Demographic Information

Within the 4,232 acres represented in the survey, very small farms, small farms, medium farms, and large farms accounted for 122, 426, 918, and 2,766 acres, respectively (Table 1).

Although different in many ways from farmers in other parts of the country, the "primary farmer/grower" on Massachusetts fruit farms, like farmers nationally, is in his/her early 50's (Table 1). By acreage, the oldest farmers (averaging 58 years old) were in the very small size category. (For obvious reasons, one entertaining response of "older than dirt" could not be included in the summarized results.)

The majority of production from all farms is sold

Table 1. Demographic information supplied by Massachusetts fruit growers responding to a mail survey, 1995.

Category	Very small	Small	Medium	Large	All farms
Average Farmer Age	58	56	50	51	53
Percent of crop sold:					
Wholesale	25	19	48	75	62
Retail	75	81	52	25	38
Number of full time employees	0.5	1.0	1.1	3.6	—
Total number of acres represented	122	426	918	2766	4232

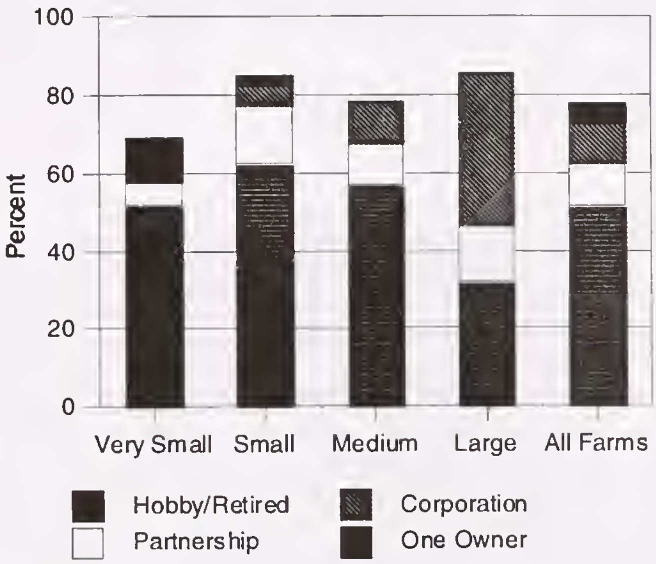

Figure 1. Business types among Massachusetts fruit growers responding to a mail survey in 1995.

wholesale (62%) rather than retail (38%). By farm size category, the majority of production from very small and small farms is sold retail, medium farms sell approximately equal percentages wholesale and retail, while large farms are predominantly wholesale operations. Not surprisingly, large farms employ the largest number of full-time employees.

Figure 1 describes the types of business organizational models most often used by Massachusetts fruit growers. Although the survey was intended to be sent only to active commercial fruit growers, 11% of very small growers and 3% of small growers described their fruit growing operation as "hobby", or "retired". As one would expect, none of the medium or large growers described their business in those ways. Regardless of farm size, the most frequent type of business model reported used is "one owner" (52%), followed closely by "partnership" and "corporation", except for large farms, where corporations are most the most common model (39%), followed by one owner and partnerships (32% and 14%, respectively). In addition to the above, a small number of respondents (3 %), described their farm as either a Chapter S Corporation, trust, or a school farm.

Computer Use

Another general question asked about respondents use of computer technology on their farms. Somewhat surprisingly, given Massachusetts reputation as a "high-tech" state, almost 47 percent of respondents replied that they do not use a personal computer on the farm. It is possible that this percentage is even higher, given that 16 percent of survey respondents left the question blank, potentially indicating non-use. Relatively low computer use may indicate a need for Extension training in this area.

As noted in other questions, responses varied greatly according to farm size. A total of 61% of large farms reported computer use, compared to only 24 % of very small farms. Small and medium farms were intermediate in reporting computer use (35% and 46%, respectively).

Across all sizes of farms, payroll was the most common sort of computer use (21%), followed by pesticide record-keeping (17%), and inventory control (14%). In spite of the popularity of the Internet, and other on-line services, only 8% of respondents said that they used a computer for telecommunication, and a still smaller percentage reported using computers for keeping records of IPM monitoring. A single individual replied that s/he used a computer for IPM decision support (e.g., expert systems). It remains to be seen if use of computerized IPM decision support and record keeping would increase if suitable software and use training were made available, or if current low reliance on computers for those purposes (as well as for telecommunication) is linked with the current age distribution of Massachusetts apple growers.

1995 Tree-fruit Survey: Horticulture

Wesley R. Autio, Roberta Szala, and William M. Coli
University of Massachusetts

During the spring of 1995, the Extension Tree-fruit Team conducted a survey of tree-fruit growers in Massachusetts to determine what methods of education they most valued and what topics should receive more or less attention by the Team. Seventy-five percent of 210 growers responded to the survey. In this article the results pertaining to the horticultural questions are presented.

Figure 1 displays the perceived importance of the various sources of horticultural information generated by the Tree-fruit Team. In general growers felt that the computer-based bulletin board INFONET was less than somewhat important, while they found maturity alerts, the Annual Summer Meeting, and the irregularly scheduled late winter meeting to be slightly more than somewhat important. Respondents saw the New England Fruit Meetings and personal visits by Team members to be slightly less than important. *Fruit Notes* and twilight meetings ranked a slightly more than important, and the *New England Pest Management Guide* and the *Tree Fruit Newsletter*

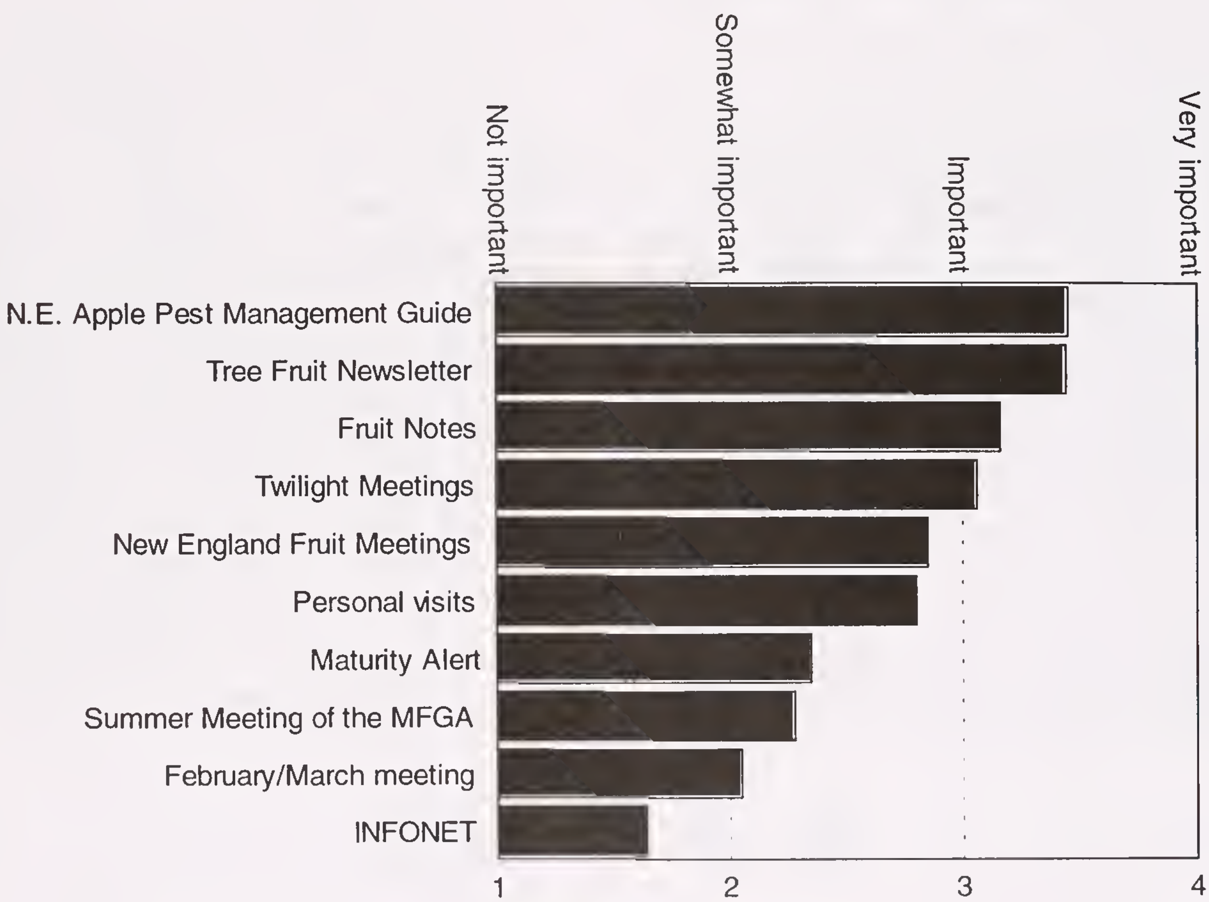

Figure 1. Grower ratings of the relative importance of various educational tools used by the Extension Tree-fruit Team.

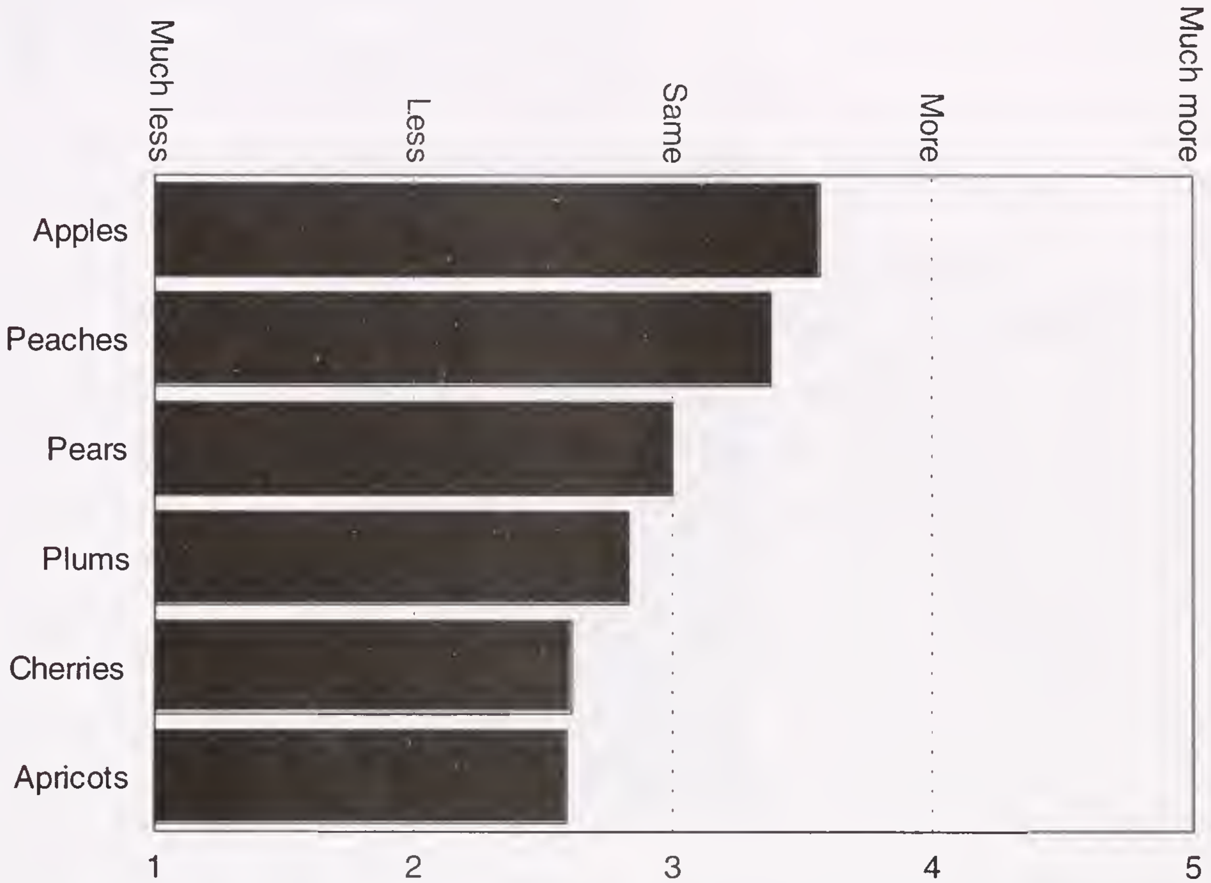

Figure 2. Grower suggestions of potential changes in the emphasis placed by the Extension Tree-fruit Team on various tree-fruit crops.

were thought to be between important and very important. Clearly, growers had distinct feelings about the relative value of these various tools. It is interesting to note that there were differences between growers of small acreages and those of large acreages with respect to a few of these information sources. Generally, the larger the grower, the more likely they were to find meetings of greater importance, and the smaller the grower, the more likely they were to find the *Tree Fruit Newsletter* of greater importance.

Figure 2 presents the results regarding the relative emphasis placed on horticultural aspects of different tree-fruit crops. Specifically, growers were asked if we should provide the same effort, more effort, or less effort with respects to apples, peaches, pears, plums, cherries, and apricots. The average levels for pears, plums, cherries, and apricots suggested that we should not emphasize these crops any more than we currently do. The responses for apples and peaches suggested an interested in enhanced efforts. There were no significant differences in recommendation with regard to orchard size.

The next assessment related to various aspects of horticultural management (Figure 3). For all topics, growers suggested that the Team maintain or increase current efforts, with very little difference among topics. Nutrient management, stop-drop chemicals, pruning and training semid-warf trees, chemical thinning, and high-density training received the highest ranking, and cultivar evaluation, weed management, rootstock evaluation, and maturity and harvest management received the next highest. Storage management received the lowest rating, but on average, growers felt that the Team should maintain current levels of activity. Some variation with orchard size was seen. Specifically, as orchard size increased, growers said that they would like to see a greater

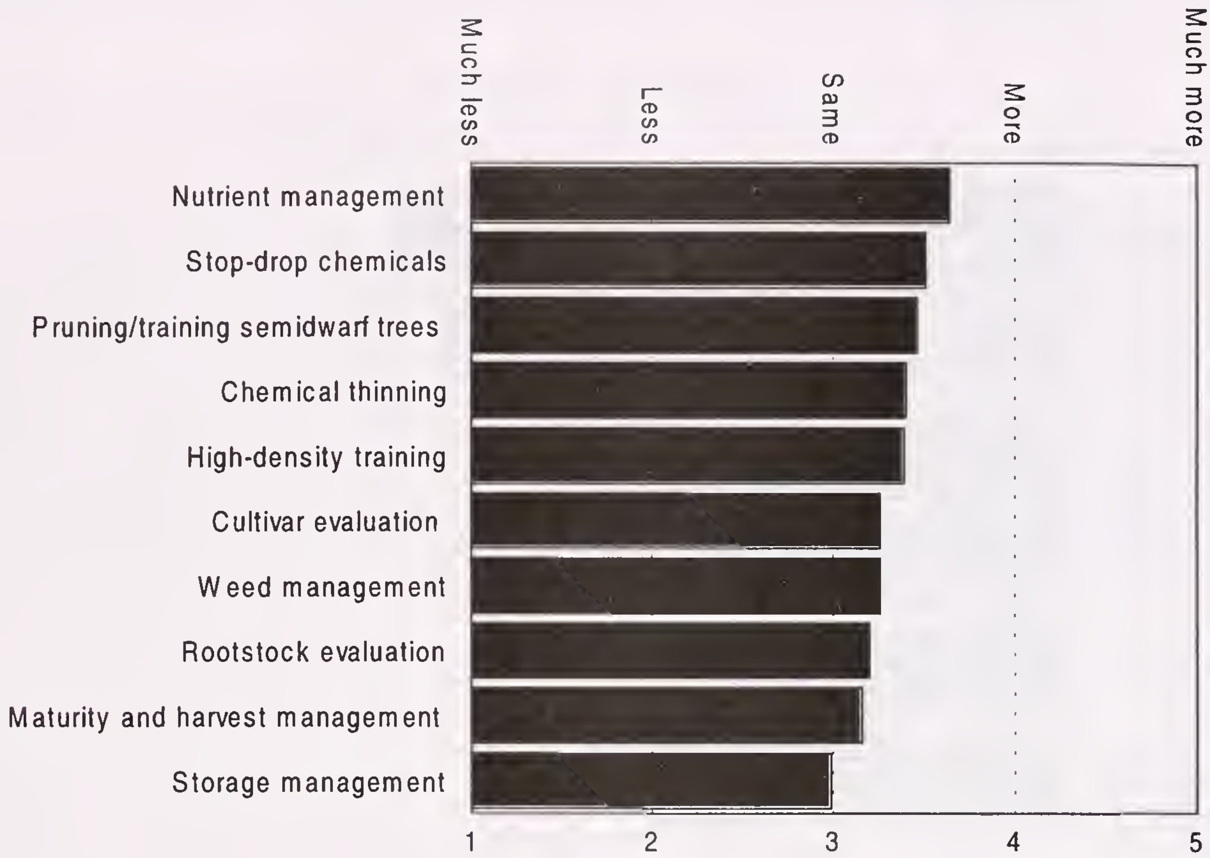

Figure 3. Grower suggestions of potential changes in the emphasis placed by the Extension Tree-fruit Team on various aspects of horticultural management.

emphasis on stop-drop chemicals, chemical thinning, high-density training, maturity and harvest management, and storage management and a lesser emphasis on pruning and training semidwarf trees.

This survey was a valuable experience. It showed the Tree-fruit Team where it should be placing its subject-area emphasis and how it should be disseminating information and providing education. Adjustments in activities have occurred and will continue to occur based on this survey and future, similar surveys.

1995 Tree-fruit Survey: Disease Management

Daniel R. Cooley, Roberta Szala, and William M. Coli
University of Massachusetts

In the summer of 1995, the University of Massachusetts Extension Tree Fruit Team surveyed apple growers in the state for their opinions and practices regarding pest management in their apple orchards. This article describes the survey results related to disease management, largely addressing extension programming.

Growers were asked to what extent they would like to see efforts made concerning chemical control of tree fruit diseases. Table 1 lists the diseases and responses for various sized orchards. Any response above a 2 indicates that more effort was desired, while less than 2 indicates less effort was desired. Growers expressed the most interest in getting new chemical disease-management information for peach brown rot. Next came four apple diseases, flyspeck, sooty blotch, scab, and fire blight. Finally, there was marginal interest in getting more information on summer fruit rots, calyx end rot, and replant problems. Larger orchards were interested in the Tree-fruit Team placing more emphasis on storage disease management, while medium and smaller orchards did not rank storage problems highly. The smallest orchards were most concerned about new information on scab control.

A similar question asked if the same set of diseases should receive more or less effort with regards to biological control (Table 2). The mean response was generally higher than for chemical control, likely meaning that growers felt that more biological control information is needed for all disease problems. The most emphasized diseases were similar to those for chemical control, with apple scab, flyspeck and sooty blotch ranked most highly. Larger farms ranked replant and storage highly, while smaller orchards found these problems less important.

The responses indicated that growers would like to see an increased emphasis placed on developing and learning about new methods of management for peach brown rot, apple scab, flyspeck, sooty blotch, and fire blight. The largest orchards would like more information on management strategies for orchard replant and storage diseases.

Table 1. Ranking of desired emphasis on new chemical control methods for tree-fruit disease problems relative to present efforts, where 1= less, 2= the same, and 3 = more.

Disease	0 to 5 acres	5.1 to 20 acres	20.1 to 50 acres	50.1 or more acres	All
Peach brown rot	2.8	2.3	2.2	2.3	2.5
Flyspeck & sooty blotch	2.3	2.4	2.3	2.4	2.4
Apple scab	2.4	2.3	2.0	2.3	2.3
Fire blight	2.3	2.3	2.2	2.3	2.3
Summer fruit rot	2.1	2.3	1.9	2.0	2.1
Orchard replant disease	1.9	2.2	2.2	2.2	2.1
Calyx end rot	2.0	2.2	1.9	2.2	2.1
Collar rot	2.0	2.1	2.0	2.0	2.0
Storage disease management	1.8	1.8	1.9	2.3	1.9

Table 2. Ranking of desired emphasis on new biological control methods for tree-fruit disease problems relative to present efforts, where 1= less, 2= the same, and 3 = more.

Disease	0 to 5 acres	5.1 to 20 acres	20.1 to 50 acres	50.1 or more acres	All
Apple scab	2.6	2.6	2.5	2.6	2.6
Flyspeck & sooty blotch	2.4	2.7	2.7	2.6	2.5
Peach brown rot	2.4	2.4	2.5	2.4	2.4
Fire blight	2.4	2.4	2.5	2.5	2.4
Summer fruit rot	2.3	2.4	2.2	2.3	2.3
Orchard replant disease	2.1	2.3	2.5	2.5	2.3
Calyx end rot	2.2	2.4	2.2	2.3	2.3
Collar rot	2.2	2.2	2.4	2.2	2.2
Storage disease management	2.0	2.1	2.3	2.4	2.2

* * * * *

1995 Tree-fruit Survey: Marketing

Karen I. Hauschild, Robert Szala, and William M. Coli
University of Massachusetts

The 1995 tree fruit survey included five questions pertaining to marketing education: either educating farmers in marketing or educating consumers about agriculture/fruit production. The first question asked growers to identify which topics are most important to their overall orchard management. Educating farmers in marketing was ranked fifth of six possibilities. The second question asked growers to identify those areas on which they thought we should place more emphasis. Educating farmers in marketing ranked fifth out of six. The third question asked which area should be emphasized to give more time to educating consumers about agriculture. Educating farmers about marketing ranked number one. Clearly the survey results show that the respondents do **not** feel that marketing education should be a major focus of the Extension Tree-fruit Team.

Another question asked the relative importance of various sources of information with regards to marketing decisions. The top two responses were the *Tree Fruit Newsletter* and discussions at twilight meetings. Although growers did not see marketing education as an Extension priority, they did view the *Newsletter* and twilight meetings as a source of information on marketing issues.

Also it was asked on what topics within marketing growers wished to see a greater emphasis placed by the Tree-fruit team. In general, growers felt that the same or more emphasis should be placed on each activity. The top three responses were developing consumer fact sheets, developing press releases, and alternatives to the present (marketing) situation.

Although growers perceive marketing to be unimportant to Extension's Tree-fruit efforts, there clearly is concern over consumer education on tree fruit production and fruit availability (press releases). Promoting the industry has not been a traditional Extension activity, but rather has been an objective of various other organizations, including the Massachusetts Department of Food & Agriculture, the NY-NE Apple Institute (and NE McIntosh Growers Association), the packing/shipping brokers (e.g., J.P. Sullivan Co., VT Apple), and of the Massachusetts Fruit Growers' Association. For the marketing educational outreach of the Extension Tree-fruit Team, it seems more appropriate to develop informational fact sheets for consumers and press releases regarding the tree-fruit industry in Massachusetts. "Buying Local" could be the underlying theme, but perhaps not the direct focus of these efforts.

An issue that was not addressed specifically in this survey is that marketing education has **not** been a "traditional" effort for the Tree-fruit Team. Massachusetts tree-fruit producers have a strong "traditional" focus. They have not seen marketing/promotion as an overall emphasis. This issue could have had a significant effect on survey responses.

* * * * *

1995Tree-fruit Survey: Insect Management

Ronald J. Prokopy, Roberta Szala, and William M. Coli
University of Massachusetts

As revealed in a preceding article on the 1995 Tree-fruit Survey, growers expressed the opinion that insect pest management, like disease pest management and horticultural management, ought to receive increased emphasis relative to our current efforts in these areas. In this article, we first describe survey results of grower ranking of current extension efforts most beneficial to insect pest management decisions. We then present grower ranking of insects that should receive priority in terms of our future research efforts on improved chemical control and improved biologically-based control.

Current Extension Efforts

As revealed in Table 1, the annual *New England Apple Pest Management Guide* and the annual 18 weekly pest alert messages were considered by "all" growers (that is, growers across all farm sizes) to be the most beneficial of all extension efforts in affecting insect pest management decisions. These were closely followed by the *Annual March Message*. Somewhat further down the list, in descending order of expressed value, were the annual twilight meetings at growers orchards, personal visits by a member of the extension team to a grower's orchard, issues of *Fruit Notes*, the biannual *Southern New England Peach, Pear and Plum Pest Management Guide*, and the *Tree Fruit Newsletter*, Growers having large farms expressed essentially the same order of priority as "all" growers did. Growers having medium-size farms gave comparatively higher ranking to the Annual March Message and *Fruit Notes*, whereas growers having small or very small farms gave comparatively higher ranking to the weekly pest alert messages.

Table 1. Grower ranking of current extension efforts most beneficial to insect-pest-management decisions. The lower the value, the greater the importance.

Extension effort	Very small farms	Small farms	Medium farms	Large farms	All farms
New England Apple Pest Management Guide	2.8	3.7	2.5	3.0	2.9
Weekly pest alert messages	2.6	3.1	3.5	3.2	3.0
March Message	3.7	3.4	2.9	3.9	3.5
Twilight meetings	4.1	4.2	4.8	4.2	4.3
Personal visits by Tree-fruit team members	4.0	4.5	5.1	4.6	4.5
Fruit Notes	4.9	4.2	4.2	5.6	4.7
Southern New England Peach, Pear and Plum Pest Management Guide	4.1	5.2	4.5	5.5	4.7
Tree Fruit Newsletter	4.7	4.5	5.4	6.0	5.0

Table 2. Grower ranking of insects that should receive priority for improved chemical control efforts. The greater the value, the higher the priority. Assigned values of 1, 2, or 3 = less, same, or greater priority relative to current efforts.

Insect	Very small farms	Small farms	Medium farms	Large farms	All farms
Plum curculio	2.5	2.3	2.2	2.1	2.3
Peach pests	2.5	2.3	2.0	2.0	2.3
Mites	2.3	2.3	2.1	2.4	2.3
Leafminers	2.4	2.3	2.0	2.3	2.3
Apple maggot	2.4	2.2	2.1	2.1	2.2
Leafhoppers	2.1	2.2	2.1	2.2	2.1
Plant bugs	2.0	2.0	2.1	2.0	2.0
Leafrollers	2.2	2.0	1.9	1.9	2.0
Codling moth	2.1	2.1	1.9	1.9	2.0
Sawfly	2.1	2.0	2.0	1.8	2.0
Aphids	2.1	2.0	1.9	1.8	1.9
Pear Pests	1.8	2.1	1.8	2.0	1.9
Plum Pests	1.9	2.0	1.7	1.7	1.8

Priority Insects for Improved Chemical Control Efforts

As shown in Table 2, growers across all farm sizes combined ranked plum curculio, peach pests, mites and leafhoppers as priority insect pests for increased chemical control efforts. These were closely followed by apple maggot and leafhoppers. Of lesser priority were plant bugs, leafrollers, codling moth, and sawflies. Of least priority were aphids, pear pests, and plum pests. Growers having small farms expressed essentially the same order of priority as "all" growers did. Relative to all growers, growers having large farms gave comparatively higher priority to mites; whereas, growers having very small farms ranked mites as being of lesser priority than plum curculio, peach pests, leafminers, and apple maggot.

Priority Insects for Improved Biologically-based Control Efforts

As given in Table 3, growers across all farm sizes combined ranked mites and plum curculio, closely followed by leafminers and apple maggot, as priority insect pests for greater effort in biologically-based control. Next in priority were plant bugs and leafhoppers, followed by peach pests, sawfly, aphids, codling moth, and leafrollers. Of least priority were pear pests and plum pests. Growers having medium and large farms placed greatest emphasis on mites; whereas, growers having very small farms placed greatest emphasis plum curculio and apple maggot.

Conclusions

We perceive the results of this survey to be of great value in guiding the course of our future research and extension efforts in insect pest management on tree fruits in Massachusetts. The results already have stimulated us to continue with vigor our efforts to develop a monitoring trap for plum curculio so that chemical controls can be timed better, to continue to pursue our intent of developing a biologically-based method of controlling apple maggot using odor-baited pesticide-treated spheres, to expand our efforts to establish *Typhlodromus pyri* mite predators in a greater proportion of Massachusetts commercial orchards so as to enhance the probability of biological mite control, and to initiate research on improved chemical control of peach

Table 3. Grower ranking of insects that should receive priority for improved biologically-based control efforts. The greater the value, the higher the priority. Assigned values of 1, 2 or 3 = less, same, or greater priority relative to current efforts.

Insect	Very small farms	Small farms	Medium farms	Large farms	All farms
Mites	2.6	2.5	2.8	2.8	2.7
Plum curculio	2.7	2.5	2.8	2.6	2.7
Apple maggot	2.7	2.5	2.7	2.5	2.6
Leafminers	2.6	2.5	2.7	2.6	2.6
Plant bugs	2.5	2.5	2.6	2.5	2.5
Leafhoppers	2.5	2.5	2.7	2.6	2.5
Peach pests	2.4	2.5	2.6	2.3	2.4
Sawfly	2.5	2.4	2.5	2.3	2.4
Aphids	2.5	2.4	2.5	2.3	2.4
Codling moth	2.4	2.4	2.5	2.2	2.4
Leafrollers	2.4	2.4	2.4	2.1	2.4
Pear pests	2.3	2.3	2.4	2.1	2.3
Plum pests	2.2	2.3	2.1	2.0	2.2

pests, particularly plant bugs and stink bugs. The results also serve as a catalyst for our doing the best possible job we can in contributing to an up-to-date *New England Apple Pest Management Guide* and in generating weekly pest alert messages and the *Annual March Message*.

* * * * *

1995 Tree-fruit Survey: Integrated Pest Management

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University of Massachusetts

Identifying Research and Extension Needed to Enhance IPM Adoption

In September, 1993, the federal administration announced a joint USDA, EPA, and FDA policy endorsing the use of IPM by agriculture and related industries and setting a goal of 75% of U.S. crop acreage under IPM by 2000. In response to setting of this goal, the USDA announced a national IPM initiative "based on the premise that: 1.) involving farmers and practitioners in the development and assessment of IPM programs increases implementation of IPM practices; and 2) increasing the use of IPM systems enables farmers to achieve both economic and environmental benefits." As part of the USDA National IPM Initiative, university research and extension staff nationwide have been asked to better understand grower needs in the area of IPM. It is hoped, that, by showing the US Congress that the needs of constituents (voters) are being addressed by the Land Grant University System, current levels of federal support can be maintained or even increased. Another important component of efforts to identify and prioritize key research, extension, or training needs is also to characterize IPM systems that are now ready for adoption, as well as current levels of actual adoption by the end user.

Assessing Current Levels of IPM Adoption

The whole question of how one measures IPM adoption currently is a subject of intense discussion and debate nationally. While measuring adoption would seem relatively easy to accomplish given a large enough sample size, in practice it turns out to be much more difficult. For example, a study conducted by MacDonald and Glynn of Cornell University, which allowed growers to "self define" whether or not they used IPM, found large differences between the percent of growers who said they practiced IPM, and the percent actually using such key elements of IPM as pest monitoring and valid action thresholds. Hence, some less subjective measure is probably needed.

Another way of measuring adoption was used by the USDA Economic Research Service in a 1994 study of field crops, fruits and nuts, and vegetables. For this study, which looked at cropping practices for the years 1990-1993, USDA considered acreage as under "low-level IPM" if decisions were based on scouting and the use of thresholds. To be classified as "medium-level IPM," USDA required that scouting and adherence to thresholds be used plus an additional one to two IPM practices from a list considered by USDA to be "indicative of an IPM approach." "High-level IPM" meant that scouting and thresholds were used plus three or more other practices indicative of an IPM approach. Clearly, this method is imperfect, given that IPM systems for some crops can involve dozens of practices.

At a recent National IPM Symposium, Dr. Polly Hoppin of the World Wildlife Fund suggested a very different approach to determining adoption. The World Wildlife Fund's approach is based largely on the ratio of practices which rely on "...treatment-oriented interventions with synthetic pesticides.. " and "...prevention-based practices that reduce pest pressure, increase plant competitiveness, and/or enhance biological control processes..." According to their model, simply monitoring pests and applying pesticides according to thresholds constitutes "no IPM," given that it relies exclusively on a treatment-based rather than prevention-based strategy. A key difficulty with this approach is that growers would get no recognition for use of what we in Massachusetts call "first-level IPM" (i.e., systems based on monitoring and use of thresholds which take into account all classes of pests, but which rely largely on chemical pesticides). In order to be a "high-level IPM" user according to the World Wildlife Fund, the farmer would need to be functioning at Prokopy's "second stage" of IPM where behavioral, cultural, and biological controls predominate, and broad-spec-

trum pesticides are avoided to the greatest extent possible.

Still another approach to measuring adoption is the use of the commodity-specific IPM guidelines first developed in Massachusetts. By listing all valid, available IPM practices, the guidelines allow a very simple assessment of how many are being used on an individual farm, and a characterization of adoption along a continuum from low (e.g., up to 30% of total practices), to medium (e.g., 30% to 70%), and to high (e.g., over 70%). Because guidelines can be updated to include new, biologically-based practices as they are developed and found to be viable, they allow growers to be recognized for use of both first- and second-level IPM adoption. We continue to believe that IPM guidelines represent a useful and objective tool for measuring grower IPM adoption, and we will continue our efforts to use them for this purpose.

Assessment of Grower Needs and IPM Adoption in Massachusetts Orchards

Attempts to measure accurately both IPM adoption and grower research/extension needs have been the long-standing policy both of the Massachusetts IPM Program, and the UMass Extension Tree-fruit Team. Many readers undoubtedly have responded to informal surveys for this purpose conducted by team members at twilight meetings or other events. Others have participated directly in meetings of the Tree-fruit Advisory Committee. The statewide survey reported on in this and other related articles was an attempt to formalize the process of needs assessment, and provide data for the Tree-fruit Team and the Advisory Committee to review and respond to. In addition, Massachusetts has received a small USDA grant for the purpose of determining the level of adoption and of needs for apples and four other crops in New England and the Mid-Atlantic states. Here, we report on the responses to seven questions from the 1995 Tree-fruit Survey related to IPM.

In summarizing results of the tree-fruit survey, responses were taken on face value. That is, respondents were allowed to self define their use of IPM, and no attempt was made to determine whether or not individual practices were used in one small block versus the whole farm or every year versus only some years. No statistical analyses were conducted, so that numerical rankings should be considered a guide, rather than an absolute ranking for a category.

Table 1. Percent of respondents to the 1995 Tree-fruit Survey that said that they did or did not use IPM.

Farms size	Yes	No
All farms	77	13
Very small farms	66	16
Small farms	73	20
Medium farms	82	7
Large farms	100	0

Use of IPM

A large majority (77%) of all respondents said that they use IPM on their farm (Table 1). (Note that percentages in some categories do not total 100 due to rounding and because some respondents left this and other questions blank.) Although a self definition, we have confidence in these numbers, given that 13% honestly answered "no," and an additional 11% left the question blank, even when the obvious "right" answer (i.e., the response an intelligent reader could guess the surveyor might want) was yes.

Further support for the validity of this result, and confirmation of the trend evident in Table 1 that larger growers tended to define themselves as IPM users more than smaller growers, is found in answers to the next two questions. Over all farms, 72% of respondents reported engaging in direct observation of pests or beneficials, 69% selected pesticides to conserve beneficials, 63% used insect monitoring traps, 56% calibrated their sprayer at least once per season, and 54 % used action thresholds and cultural controls such as summer pruning (tied). Although only 23% reported that they used disease-monitoring devices, this is higher than the number reporting (in a subsequent question) that private IPM scout/consultants do disease monitoring on the farm (16% over all farms sizes). Thus it appears that at least 7% of Mass. fruit growers see a value in using disease monitoring devices on their own, with no help from consultants.

Results of this question are even more interesting when looked at according to farm size. In virtually every case, there was a clear trend toward greater use of the practice in question on larger than on smaller farms. For example, 93% of respondents

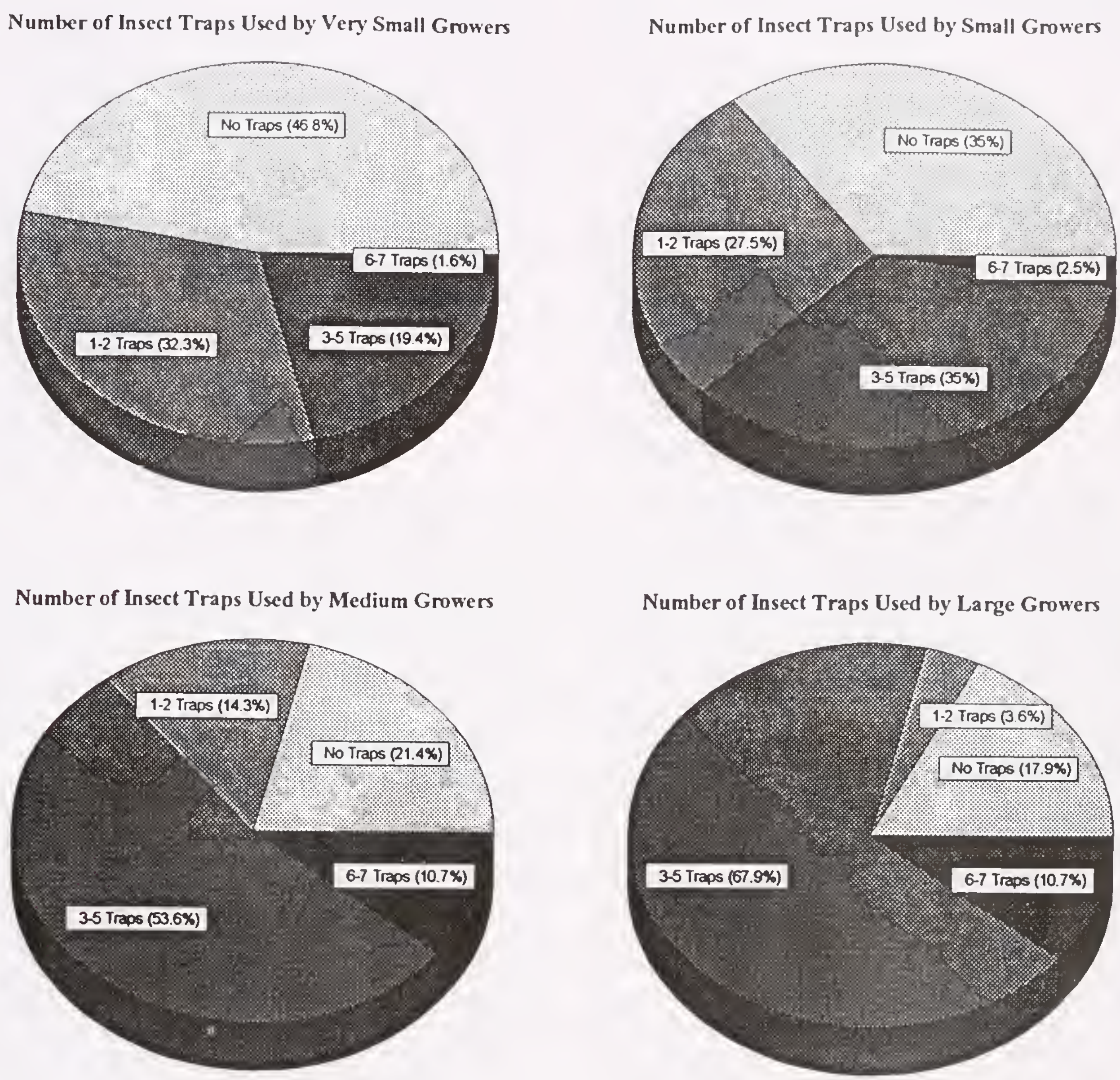

Figure 1. The percentage of each size category of orchard that monitored 0, 1 to 2, 3 to 5, or 6 to 9 insect pests with traps, as reported in the 1995 Tree-fruit Survey. Very small = 0-5 acres, small = 5.1-20 acres, medium = 20.1 to 50 acres, and large = 50.1+ acres.

from large farms said they select pesticides to conserve beneficials, compared to 79% of medium farms, 63% of small farms, and 58% of very small farms. A similar result can be seen for direct observation of pests and beneficials (86%, 82%, 73%, and 60%, respectively), use of insect-monitoring traps (82%, 75%, 60%, and 50%, respectively), sprayer calibration (82%,71%, 65%, and 32%, respectively), cultural controls (71%, 75%, 50%, and 40%, respectively), use of thresholds (70%, 68%, 65%, and 36%, respectively). Differences according to farm size are particularly striking for keeping scouting records (61%, 64%, 33%, and 15%, respectively), and use of disease-monitoring devices (54%, 43%, 15%, and 7%, respectively).

Use of Traps for Insect Monitoring

Across all farms, it comes as no surprise that the most common insect trap used is the red sphere

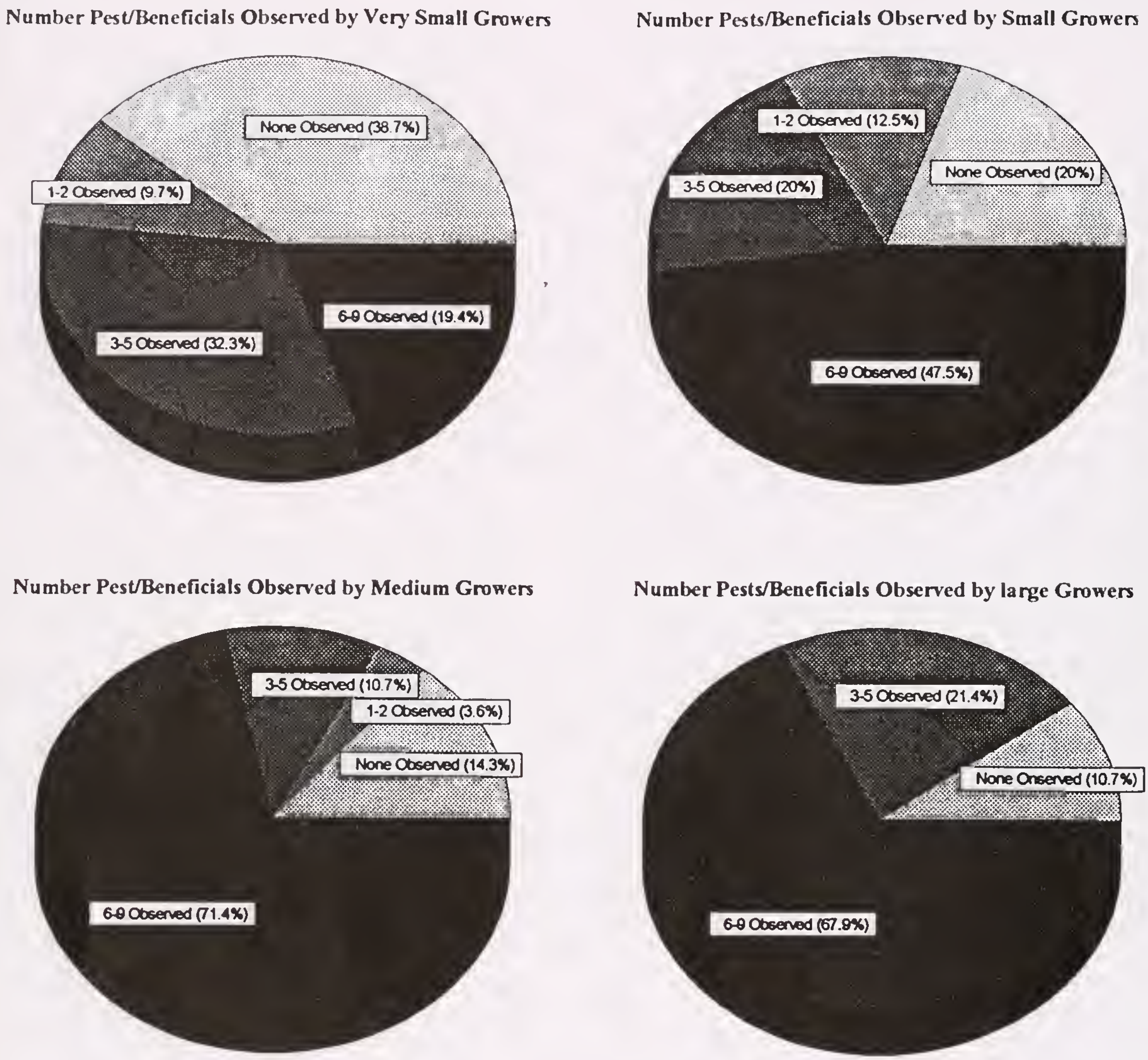

Figure 2. The percentage of each size category of orchard that monitored 0, 1 to 2, 3 to 5, or 6 to 9 pests or beneficials by direct observation, as reported in the 1995 Tree-fruit Survey. Very small = 0-5 acres, small = 5.1-20 acres, medium = 20.1 to 50 acres, and large = 50.1+ acres.

trap for apple maggot fly (AMF), which are deployed by 60% of all Massachusetts fruit growers. Next most often used is the white tarnished plant bug (TPB) trap (42%), followed by the red leafminer (LM) trap (39%), and the white trap for European apple sawfly (EAS) (36%). Least often used were any pheromone trap (17%), San Jose scale (SJS) sticky tapes (10%), and yellow board traps for AMF (10%).

Once again, use of individual traps was very dependent on farm size. Three traps were used by over 75% of large farms. It was somewhat surprising that the TPB trap was most heavily used (77% of large farms), followed by the red LM trap and the red AMF sphere (tied for use by 75% of large farms). Fourth in use was the EAS trap (64%). The only trap used by a relatively large number (50%) of very small farms was the red AMF sphere.

It is interesting to note that, while 100% of large

growers reported that they used IPM in an earlier question, almost 18% of the same group left blank the question on use of insect monitoring traps, a key component of IPM (Figure 1). Evidently, large growers felt that they were using other strategies consistent with an IPM approach, even though they were not monitoring insects with traps. Internal consistency of the data from this question and the previous one (asking which general sorts of IPM techniques were used) is demonstrated by the finding that the percentage of large growers responding that they do no use insect traps is identical to the percent who left blank the same choice previously.

Use of Direct Observation of Pests and Beneficials

Across all farm sizes, the most frequent use of direct observation was to locate and assess plum curculio (PC) injury (67% of respondents). This was followed by mites (63%), leafminer mines (61%), aphids (60%), leafhoppers (51%), leafhopper damage (42%), and leafroller/green fruitworm foliar or fruit injury (31%). Over one third of all respondents reported observations for aphid predators (37%) and mite predators (36%).

A similar correlation between farm size and use of particular techniques reported earlier was again noted in this question. Overall pests and beneficials, 86% and 89% of medium and large growers, respectively, used direct observation to monitor levels; whereas, only 61% and 80% of very small and small growers, respectively, used direct observation (Figure 2). For medium and large growers, mites and leafminer mines were tied for first place (86% and 89% for respective farm sizes) in direct observations used, replacing PC (used by 79% of both sizes). Observations of aphids (82% of large farms, 75% of medium) and leafhoppers also was used frequently (75% of both medium and large farms). It is also clear that larger growers apparently find more value in monitoring for mite predators (used by 64% of large, 54% of medium) and aphid predators (82% of large, 75% of medium) than do small or very small growers.

Who Conducts Disease Monitoring?

Regardless of farm size, the person who most often conducts disease monitoring is the survey respondent (46% of all farms), followed by private consultants (16%), some other farm employee (8%), or some unspecified other person (3%). Not surprisingly, use of a private consultant for disease monitoring was largely restricted to large (36%) and medium (32%) farms, rather than small (13%) or very small (2%) ones.

Source of Pest Thresholds

The University was the most commonly reported source for action thresholds (50% of all farms), followed by the grower's own threshold (18%) and those provided by private consultants (16%). Consistent with earlier responses, private consultant-provide thresholds were more commonly used on medium and large farms than small or very small farms.

Determining the Need for and Timing of Sprays

Ultimately, all the monitoring methods described above are conducted for one purpose: to provide knowledge to the decision-maker, and help him or her make better pest-management decisions. Consequently, we were surprised that the choice "when traps or observations indicate pests reach thresholds" only ranked fourth in importance for making pest-management decisions across all farm sizes (used by 55% of respondents). Most important was "the *New England Pest Management Guide*" (68%), which is a source of a large amount of information related to IPM. In second and third place, respectively, were "my own experience and knowledge of the orchard" (67%) and "Extension pest messages" (61%). Further down on the list were "general orchard observations" (46%), "IPM scout/consultant recommendations" (26%), "time of year" (20%), "chemical company field man recommendations" (20%), "pest sampling other than traps" (17%), "weather monitoring devices" (19%), and "label directions" (14%).

Our Conclusions

Based on the data presented here and other direct contact with growers and private-sector IPM consultants, we are confident that the tree fruit industry in Massachusetts, especially the medium and large farms representing the largest total acreage, has already achieved the USDA goal for 2000 (Figure 3). We will continue our efforts to document the extent of IPM use in the Commonwealth, and do our best to see that the actual practitioners are recognized for their outstanding levels of adoption. However, given the continued loss of important crop protection chemicals, the increasing difficulty and

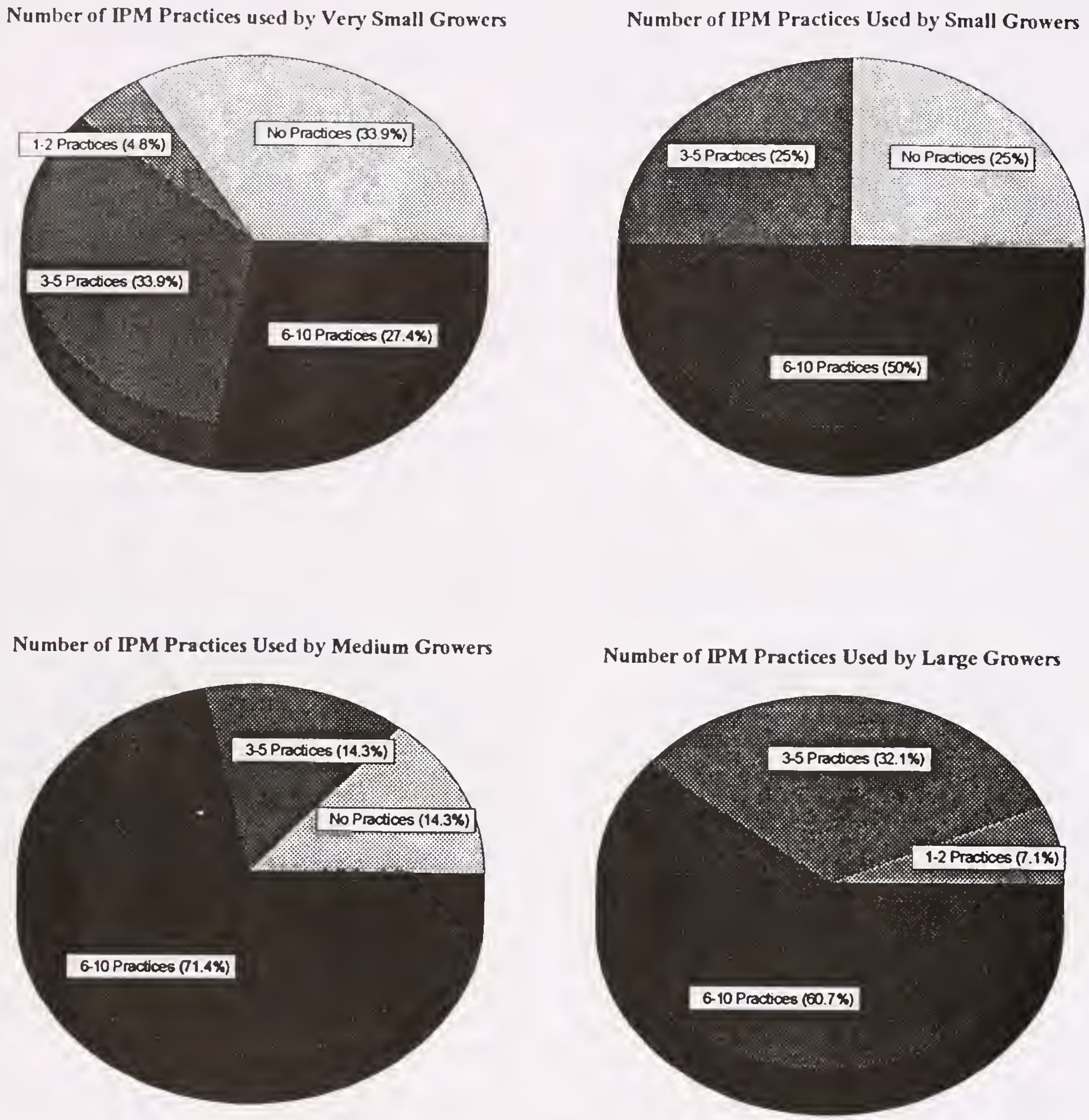

Figure 3. The percentage of each size category of orchard that used 0, 1 to 2, 3 to 5, or 6 to 10 IPM practices. Very small = 0-5 acres, small = 5.1-20 acres, medium = 20.1 to 50 acres, and large = 50.1+ acres.

cost of managing such key pests as summer diseases, plum curculio, apple maggot, and mites, and the likelihood that environmental advocates and regulators will continue to push for use of production systems which are *biologically* rather than *chemically* based, we recognize that much work still needs to be done. The Tree Fruit Team will continue its efforts, alone and in collaboration with other university specialists and the private sector, to better understand grower needs relative to IPM, and work diligently to develop and demonstrate apple pest management and production systems for the 21st century.

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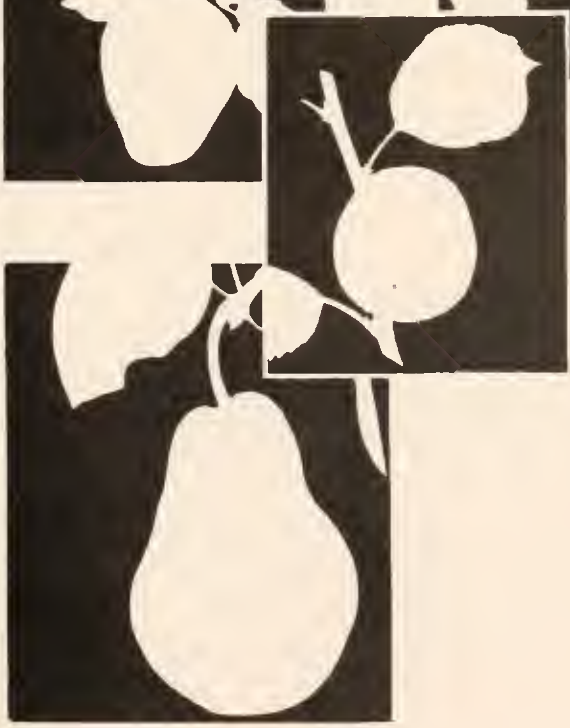
Editors: Wesley R. Autio and William J. Bramlage



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UMASS EXTENSION POLICY:

Evaluation of Odor Lures for Use with Red Sticky Spheres to Trap Apple Maggot Flies

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Red sticky spheres have shown promise as an alternative to insecticide for control of apple maggot flies in orchards. Such spheres resemble ripe apples in size, shape, and color and are visually attractive to maggot flies at distances of up to about one yard. To increase the effectiveness of these spheres, odor lures also can be used, which serve to draw flies from greater distances. In a study in 1995, we tested two odor lures known to be attractive to apple maggot flies in combination with red sphere traps in commercial orchards. The odors were butyl hexanoate (an odor emitted by ripening apples) and ammonium carbonate (an odor emitted from fly food sources such as bird droppings). Butyl hexanoate is thought to be more attractive to older, reproductively mature flies (with a large egg load) seeking fruit in which to lay eggs. Ammonium carbonate may be more attractive to younger flies (with a small or no egg load) seeking protein sources necessary to achieve sexual maturity. We hoped to discover which odor (or odors) would optimally increase fly captures on spheres.

Materials & Methods

Each butyl hexanoate lure consisted of a capped 15-ml polyethylene vial filled with liquid hexanoate, which diffused through the walls of the vial. Butyl hexanoate currently is available from commercial sources as formulated product in ready-to-use dispensers. Each ammonium carbonate lure was a commercial type (produced by Heath, Gainesville, FL), consisting of a sealed plastic container with 1.7 grams of ammonium carbonate dispensed from a small hole (a plastic flap covered the hole to protect against rainfall). Although these ammonium carbonate lures are not available for widespread commercial use, they represent prototype lures that could be obtained easily by growers.

For our tests, four growers in central and western Massachusetts generously agreed to allow us to use trees in their orchards. In each orchard, we selected plots of about 50 trees (based on similarities in tree size and spacing) which were located at the corners of larger orchard blocks. Red spheres and lures were hung on the perimeter trees of each plot at a spacing of about five 5 yards between traps (about 14 traps per plot). Traps were hung about 5 feet above ground (depending on tree size) so that there was no fruit or foliage within 8 inches of a trap (but as much as possible outside of 8 inches).

We tested four combinations of odor lures: (1) butyl hexanoate only, (2) ammonium carbonate only, (3) both butyl hexanoate and ammonium carbonate, and (4) no odor. Each orchard plot was assigned one of these odor treatments. Odor lures were placed within 8 inches of the spheres (usually on the same branch).

Traps were deployed initially during the first week in July and were maintained through mid September. Once every 2 weeks, the traps were checked and cleaned of captured apple maggot flies and other insects. Odor baits were replaced if necessary.

Results & Conclusions

The data from this experiment are presented in Table 1. Red spheres baited with

butyl hexanoate consistently captured more flies than spheres baited with ammonium carbonate or no odor. This trend was observed throughout each of the five 2-week trapping periods. Ammonium carbonate was not effective, capturing only about as many flies as the no-odor treatment. In addition, spheres with both ammonium carbonated and butyl hexanoate were no more effective than spheres with butyl hexanoate alone. A subsequent analysis of captured females showed that there was no difference in reproductive maturity of females among odor treatments. For the most part, females captured on all of the odor treatments throughout the season were sexually mature (> 90%) and of high egg load (>20 eggs/female).

Table 1. Average number of apple maggot flies captured on odor-baited or unbaited red spheres in commercial orchards. For trapping periods "early" refers to the first 2 weeks of the month, and "late" refers to the last 2 weeks of the month.

Trapping period	No odor	Butyl hexanoate	Ammonium carbonate	Both odors
Early July	2.2	13.1	1.7	10.7
Late July	6.7	38.5	5.7	38.8
Early August	10.2	40.6	6.5	36.5
Late August	5.3	25.1	---	---
Early September	3.5	14.6	---	---

In a previous study in an artificial orchard of potted apple trees, we observed that ammonium carbonate increased maggot-fly captures on red spheres when used alone or with butyl hexanoate. However, this was not the case in commercial orchards. There are several possible explanations for the ineffectiveness of ammonium carbonate in commercial orchards. Part of the problem may stem from the design of the dispenser. Typically, under the hot summer orchard conditions of 1995, all of the ammonium carbonate would dissipate within a week of deployment, leaving an empty container for the duration of the 2-week period. In addition, we observed that the vast majority of captured females were sexually mature. Once mature, maggot flies do not require as much protein as immature flies, and therefore may not respond to a protein food odor such as ammonium carbonate. Such mature flies (with a developed egg load) are more interested in finding egglaying sites, which may also explain the greater number of captures on spheres baited with butyl hexanoate.

These findings are important for several reasons. First, ammonium carbonate should probably no longer be considered as a viable odor attractant for use with red sticky spheres in commercial orchards. Second, butyl hexanoate was shown to be very effective, capturing four to six times more flies than unbaited spheres throughout the growing season. There was some concern that later in the season, ripening apples might emit enough natural butyl hexanoate to mask the butyl hexanoate in the lures. This, however, was not observed in our study. Based on the results of this work, we conclude that in commercial orchards, butyl hexanoate is an excellent lure for use with red sticky spheres to capture maggot flies, whereas ammonium carbonate is not.

Acknowledgments

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Predicting Poststorage Scald on Delicious: Where Do We Stand?

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For some years we have been collecting data relating to scald incidence on Delicious. The major factors explored are 1) harvest date, 2) number of preharvest hours/days in which the temperature falls below 50°F, and 3) starch score at harvest. These factors have been shown to influence scald susceptibility. Later harvest, more hours/days below 50°F, and higher starch scores (more mature fruit) all result in less scald after storage. Harvest date is an important factor, but since scald severity varies greatly from year to year even when fruit are harvested the same month and day, other influences clearly are also important in determining scald susceptibility.

Rather than trying to predict the exact probability of a fruit developing scald (an impossible task), we divide fruit into three categories: lots from which more than 60% of fruit are likely to scald, lots from which fewer than 20% of fruit are likely to scald, and those in between. A lot, for our current purposes, is a bushel of apples harvested from adjacent (up to 5) trees of the same age, strain, and rootstock. The idea behind these divisions is that if over 60% of fruit will scald without treatment, then it is probable that in order to control scald effectively, the maximum concentration of

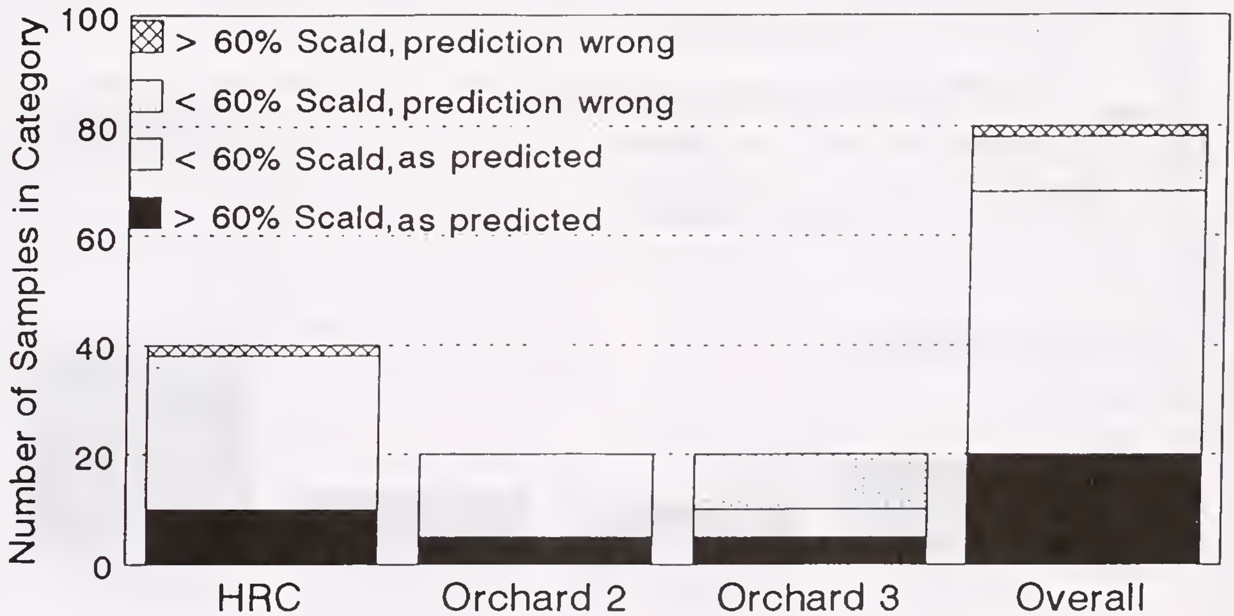

Figure 1. Predicting severe scald (>60% of fruit) on Delicious, 1995. Equation was developed from data collected at the University of Massachusetts Horticultural Research Center, 1988-93. If [8.4 - 0.32(day #) + 0.055 (days < 50°F) - 0.055(starch score)] > 0, then it is predicted that > 60% of the fruit will scald.

2000 ppm DPA will be needed. If fewer than 20% of fruit scald, the scald severity on individual fruit is generally not as great as in the "over-60%" group, and a DPA/fungicide drench may not be recommended at all.

Using data from 213 lots of Delicious fruit grown at the University of Massachusetts Horticultural Research Center (Belchertown) (HRC) from 1988 to 1993, equations were generated to place fruit into the above groups. Lots included fruit harvested from 14 September to 22 October, with starch scores ranging from 1 to 7. From 3 to 39 preharvest days below 50°F beginning 1 August were recorded. The equations were used in 1995 to attempt identification of scald-susceptible (>60% of fruit) and scald-resistant (<20% of fruit) lots of Delicious apples. Eight harvests were made at the HRC and four harvests were made at each of two other orchards. Equations and results are shown in Figures 1 and 2.

Overall, the equations were quite effective in identifying those fruit which were especially scald susceptible or especially scald resistant. The situations which potentially cause problems are those which are shown as x's in Figures 1 and 2. Predicting less than 60% (Figure 1) or less than 20% (Figure 2) scald when more actually occurred could result in undertreatment of fruit and subsequent fruit loss. Savings could be made for the lots which are shown in white, as these fruit could receive less DPA than the standard treatment. This possibility was examined in a further study described below.

The fruit lots used to generate and test the equations above received no postharvest treatment, and were kept in cold storage for 20 to 25 weeks after harvest, then at room temperature, about 70°F, for a week before being rated for presence of superficial scald. However, additional fruit were harvested in 1995 from the HRC and from Orchard 2 in Wilbraham. These fruit were dipped in 500, 1000, 1500, or 2000 ppm DPA, stored, and scald rated along with the other fruit. Figure 3 shows

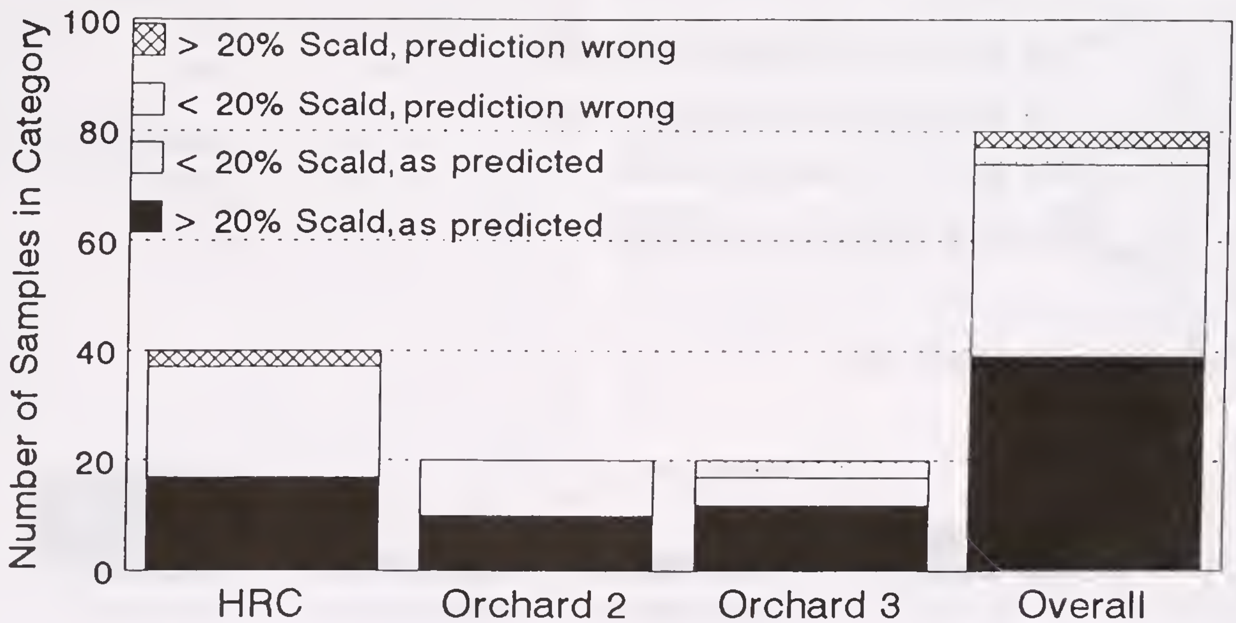

Figure 2. Predicting reduced scald (<20% of fruit) on Delicious, 1995. Equation was developed from data collected at the University of Massachusetts Horticultural Research Center, 1988-93. If [-11.8 + 0.41(day#) - 0.030(days , 50°F) - 0.71(starch score)] > 0, then it is predicted that < 20% of the fruit will scald.

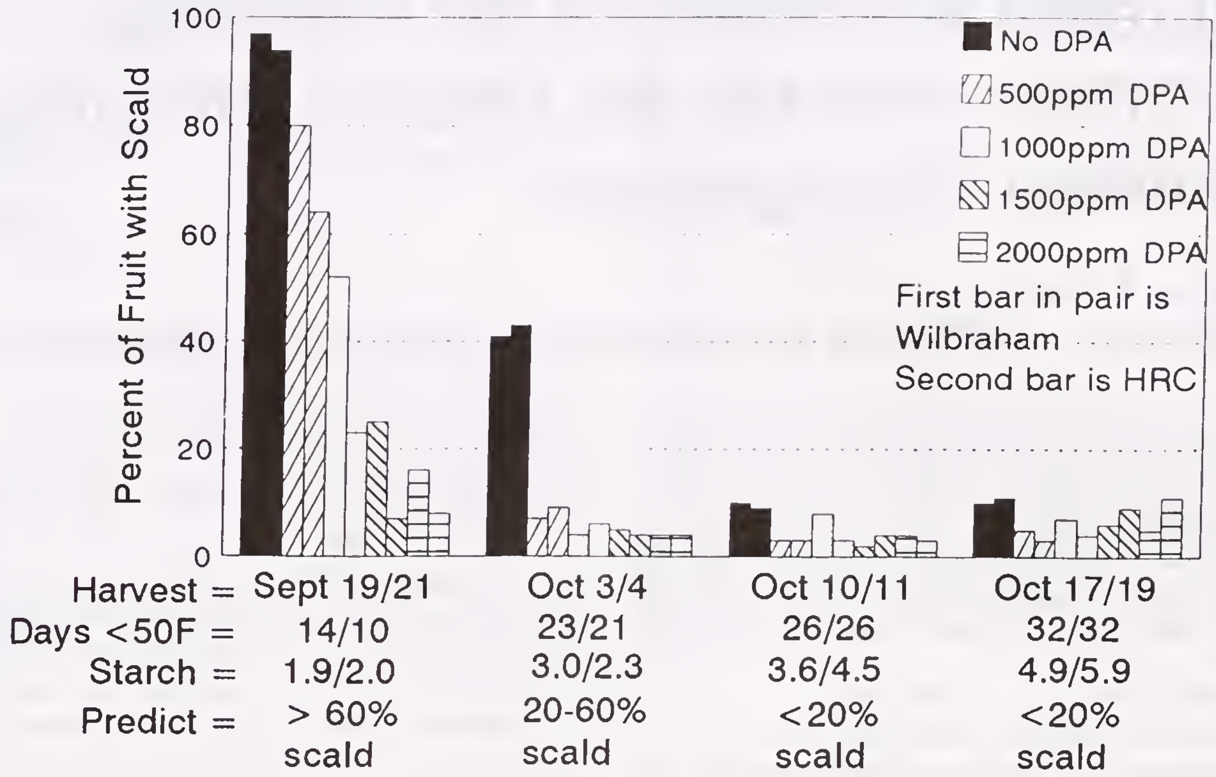

Figure 3. Effects of DPA concentration and harvest date on scald development , 1995.

how the dipped fruit fared after storage.

Based on these limited data from 1995, it appears that the eariest harvested fruit needed 2000 ppm DPA to control scald, but none of the others did. A 500ppm treatment was adequate for the second harvest, and DPA provided no benefit for fruit from the last two harvests. It should be noted that rating fruit from the last harvest was difficult since the fruit were in poor condition, and probably not all superficial browning was really scald.

All the data included here are from orchards within 35 miles of the HRC [HRC and Orchards 2 (Wilbraham) and 3 (Storrs, CT) in the figures], and they have climates similar to that at the HRC, so it is not clear that these equations will be appropriate for other areas. The balance of calendar date, preharvest hours/ days below 50°F, and starch score is important in generation of the equations. Some may wonder that increasing the number of preharvest days below 50°F would increase the likelihood of scald incidence, and that decreased starch score (less mature fruit) could lead to reduced scald resistance. The reason for this apparent contradiction is that these three variables are themselves interrelated such that, for example, scald may decrease with later harvest, but the rate of decrease may slow later in the season when the temperature is cooler and fruit are riper. Because of the importance of these relationships, and because the relationships will be different in different climates, we are expanding the area of data collection this year to see how effective our equations are in both cooler and warmer regions, and we will report on Cortland as well as Delicious. We should have some results in the spring!

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Nutrient Management for Peaches. I. Introduction to the Factors Affecting Nutrient Management

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Nutrient management is not only related to which elements to apply and when but also to how ground cover, pH, and soil structure affect nutrient availability and to the economics of various management approaches. Proper site management **before** planting plays an important role in the success of an orchard block as well.

Following is a discussion of the major factors that affect nutrient availability in peach orchards. For this discussion the focus will be on mature plantings on a properly prepared site.

Orchard-floor Management

Young peach trees are very poor competitors for nutrients and for water. The use of living ground covers - native or seeded - can result in poor tree growth, reduced (availability of) soil moisture, reduced leaf N levels, and increased problems with insects, diseases, and nematodes. Results of a study conducted in peach orchards in North Carolina showed that after two growing seasons, peach trees grown in cultivated soil, 25% Bermudagrass, or 50% Bermudagrass had greater trunk diameters than peach trees grown with native weed species, 75% Bermuda grass, or 100% Bermuda grass. Trees in the smaller of the two groupings were up to 67% smaller than those in the larger grouping.

In the late 1980's, studies conducted in West Virginia suggested that trees grown in undisturbed killed sod (K-31 tall fescue) had greater growth and fruit yield than trees grown in a vegetation-free system. The killed sod slowed the loss of soil organic matter, increased water filtration rates, and reduced runoff.

Crop Removal of Nutrients from the Soil

According to 1973 figures, peaches use the following pounds of nutrients per acre per year: 79 lbs. nitrogen (N), 21 lbs phosphate (P_2O_5), 90 lbs potash (K_2O), 92 lbs calcium (Ca), and 23 lbs. magnesium (Mg). This is not necessarily the amount of each nutrient that should be applied. Efficiency of uptake greatly affects the amount of each element that should be applied (refer to paragraph below).

Effects of pH on Nutrient Uptake

Each nutrient has a pH range at which it is most efficiently taken up by plant roots (Table 1). Because soil pH plays a major role in nutrient availability, frequent soil testing is recommended in order to monitor soil pH. The relative level of each nutrient, as reported in a soil test analysis, indicates the amount present in the soil, but not necessarily the amount available to the plant roots. The pH alone and

Table 1. The effects of pH on the relative efficiency of uptake of nitrogen (N), phosphorus (P), and potassium (K).

pH	N	P	K	Overall
7.0	100	100	100	100
6.0	89	52	100	80
5.5	77	48	77	67

soil moisture level influence uptake. Analysis results reflect not only what is present in the soil, but also how available these nutrients have been to the plants. For this reason, leaf tissue analysis is a much more reliable indicator of nutrient levels in the plant itself.

Effects of Water on Nutrient Availability

All important elements, even under optimal conditions, must be dissolved in water (in solution) in order to be taken up by roots. Fertilizer application is frequently suggested just before a light rain or to be watered in for this reason, as well as to avoid volatilization of the materials applied. Therefore, since all plants require water, drought stress not only weakens trees directly but also affects nutrient availability.

How Nutrients are Applied

In general, the long-term beneficial effects of fertilizers result from applications to the soil. Foliar applications, which apply a nutrient solution onto the leaves or fruit, generally are prescribed as a rapid way to green up the leaves, add calcium to fruits, or cure deficiencies quickly. Also, form of the nutrient element - N in the ammonium form vs. the nitrate form, for example - also affects availability. Crops vary in which form of what element is best utilized. (This issue will be discussed in "Part III" of this series of articles.)

These are the major non-economic factors that influence nutrient management for peaches. Because each orchard is different, programs need to be defined for individual orchards and perhaps each orchard block as well.

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Nutrient Management for Peaches. II. Identifying Foliar Deficiency Symptoms During the Growing Season

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Diagnosing nutrient deficiencies based on observations of foliage and other plant parts is not a perfect science. With peaches particularly, symptoms of different elemental deficiencies can be similar and easily confused with symptoms of disease or insect damage, phytotoxicity, or even weather-related problems. Suspected deficiency must be confirmed by leaf-tissue analysis. Although there is a fee for this procedure, that fee is more than recovered as a result of correcting the deficiency or through savings from not applying unnecessary materials. Leaf samples for tissue analysis give the most reliable results when leaves are selected just after growth stops but before plants start translocating nutrients to their roots for storage over the winter. For Massachusetts orchardists, the optimal time for sampling occurs between mid-July and mid-August. For information on how to take a leaf sample, contact the UMass Soil and Tissue Testing Laboratory (413-545-2311), or the author (413-545-5304).

The following information is presented in order to aid growers in preliminary identification of nutrient deficiencies in peach orchards.

Nitrogen (N)

N deficiency is the most commonly observed deficiency of stone fruits. Symptoms include pale-yellowish to light-green leaves, beginning on older leaves. Leaves may also show red-to-purple spots that die and drop from affected leaves, giving leaves a "shot-hole" appearance. Oldest leaves may abscise. Other symptoms include decreased shoot and twig growth, small fruit, or early leaf drop. These symptoms may be confused with potassium deficiency (see below), X disease, or captan injury. X-disease also results in "shot holing." Trees affected with X-disease however, have tufts of green leaves at the ends of shoot growth. Tufting is not normally observed on N-deficient trees. Captan can result in foliar damage on susceptible cultivars. Rule out captan if it was not applied or if the cultivar is known not to be sensitive.

Phosphorus (P)

P deficiency is not commonly observed in Massachusetts peach orchards. With deficiency, older leaves appear mottled. Progressive defoliation of older leaves occurs, and stems and leaf petioles appear purple rather than green. Yield and size of fruit may be reduced. Affected fruits are highly colored, ripen early, have poor quality.

Potassium (K)

K deficiency is most often observed in early summer on leaves in the middle of shoots. These leaves become pale in color. There may also be marginal browning of leaves or leaves may roll inward. Reduced shoot growth and leaf size often are a result of K deficiency. In deficient trees, fewer flower buds are evident, fruit size is small, and fruits do not color normally, appearing dull or "dirty" orange. K deficiency may be confused with N deficiency (see above), zinc deficiency, or X disease. Zinc deficiency, however, affects terminal leaves rather than those in the mid-portion of the shoot. Leaf spots, shot holes, and tufting are

symptoms of X disease not normally associated with K deficiency.

Magnesium (Mg)

Mg deficiency often occurs on sandy soils, or in orchards that have received heavy applications of K. Symptoms include marginal chlorosis. Chlorotic tissue may die, resulting in necrosis of leaf margins. The center of the leaf remains green in an inverted-V pattern. The oldest leaves are most severely affected and usually fall in late summer, leaving shoot bases bare, but tufts of green leaves at shoot tips. These symptoms may be confused with X disease (see above), iron deficiency (see description below), or manganese deficiency. Manganese deficiency, however, results in more interveinal chlorosis.

Manganese (Mn)

Mn deficiency is not commonly found on peaches, but has been observed. Symptoms include interveinal chlorosis from midrib to leaf margin. Bands of green remain along the veins, resulting in a herringbone appearance to the leaves. Symptoms appear throughout the tree. These symptoms may be confused with Mg deficiency (see above), iron deficiency (see below), or zinc deficiency (see below).

Boron (B)

B deficiency has been observed on peaches in other sections of the United States. Since peaches are highly sensitive to excess B, however, boron has not normally been applied to peach orchards. Symptoms of deficiency include terminal dieback of twigs with weak growth below the affected terminals. Buds do not break in spring. These symptoms may be confused with winter injury.

Iron (Fe)

Fe-deficiency symptoms are common when pH is too high (sometimes referred to as lime-induced chlorosis). Symptoms include interveinal chlorosis with distinct green veins. Leaves may turn almost totally white. Terminal leaves are affected first. Symptoms may be confused with Mn deficiency, Mg deficiency, or Zinc deficiency. Symptoms of Fe deficiency are more widespread throughout the tree than those of Mn deficiency, and symptoms of Mg deficiency are more prevalent on older leaves rather than terminal leaves as with Fe deficiency.

Zinc (Zn)

Zinc deficiency is fairly common, especially in California. Symptoms include chlorotic, Interveinal mottling on older leaves. As severity increases, leaf and shoot growth are stunted, resulting in a rosetting of little leaves. Leaves may also show wavy, crinkly margins. Symptoms may be confused with Mn deficiency (see above).

Any suspected nutrient deficiency should be confirmed by leaf analysis. Since deficiency symptoms can be similar for different nutrients, leaf analysis is the only definitive method of confirmation. Note also that weather factors (for example, drought), overapplication of certain nutrients, as well as pH can each affect availability and uptake of other nutrient elements.

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Nutrient Management for Peaches. III. Developing a Nutrient-management Program for Your Orchard

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In Parts I and II of this series of articles, I described inputs and criteria that you can use to assess your peach orchard's nutrient needs. In this article, I will present information that will help you provide for the nutritional needs of your peaches based on all the inputs given previously as well as on leaf analysis standards, and on the composition of alternative sources of these nutrients.

As mentioned in the previous articles, peach leaf analysis is the best, most reliable method for determining the nutritional status of your trees. For the most comprehensive data, a companion soil test will also give the soil pH, amounts of nutrients in the soil, and other factors that can help you assess the most effective, efficient, economical, and environmentally sound nutrient-management program. To increase the value of this effort on an orchard-wide basis, be sure to take samples from all orchard blocks, or at the very least from blocks that have different soil types, planting histories, ground covers, etc. It is essential for a nutrient-management program to be custom designed for each orchard block. Although such a process is time consuming and may be cost ineffective early in the process, over time this approach will be beneficial to the trees, land, quality of fruit, and your bottom line.

Table 1. A typical soil test result.

pH	6.3
buffer pH	6.8
	low medium high very high
Nitrogen(N)	xxx
Phosphorus(P)	xxxxxxxxxx
Potassium(K)	xxxxxxxxx
Calcium(Ca)	xxxxxxxxxxxxxxxxxxxxxx
Magnesium(Mg)	xxxxxxxxxxxxxxxxxxxxxxxx
Manganese(Mn)	0.7 ppm
Boron(B)	0.0 ppm
Iron(Fe)	1.2 ppm
Zinc(Zn)	0.3 ppm
Copper(Cu)	0.5 ppm

Soil Test

For tree fruits, soil tests are recommended primarily to obtain soil pH, but soil tests provide quidelines on the relative amounts of major plant nutrients and other factors that affect soil quality as well. Table 1 gives a typical soil test.

For tree fruits, buffer pH is used to determine liming needs. To make a recommendation, we use species requirements, soil type, and buffer pH to determine the appropriate amount of lime that will be required to bring the pH to 6.5. To decide what type of lime to use, compare the relative levels of calcium and magnesium in the soil test. If the soil shows a higher level of calcium than magnesium, you should use a high-magnesium (dolomitic) lime. But if the level of magnesium is higher than the level of calcium, it would be

preferable to use high-calcium lime. In the past, it was common to apply lime once every three years, needed or not. Recently, more frequent application is recommended on an as-prescribed basis. The proper pH maintains the availability of many of the nutrients that peach trees require. Therefore, proper pH, and periodic soil analyses are important to your nutrient-management program.

In general, your soil test should show pH or the amount of lime required to reach a specific pH, and the amounts of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). These levels should all be high to very high, except for P. We normally are not concerned with P unless the level is very low. P is applied prior to planting, if needed, and then basically ignored. Leaf-tissue analysis fine-tunes this information and accurately determines the levels of these elements in the plants themselves.

Table 2. A typical leaf analysis result.

Element	Results (%)	Element	Result (ppm)
Nitrogen (N)	2.30	Zinc (Zn)	22
Phosphorus (P)	0.25	Copper (Cu)	4
Potassium (K)	1.25	Manganese (Mn)	27
Calcium (Ca)	1.35	Iron (Fe)	47
Magnesium (Mg)	0.45	Boron (B)	54

Leaf-tissue Analysis

For fruit trees, leaf-tissue analysis is the best method for determining nutrient needs. Table 2 gives the results of a typical leaf-tissue analysis. The next step is to compare these actual test results with standards that have been developed for peaches (Table 3). The ones we use were developed by Cornell University. Boron is a controversial element with peaches. The standard recommendation has been to apply five pounds of borax per ton of fertilizer before planting. More recent recommendations are to apply a small amount of boron periodically. The nutrient management program for each tree or block of trees can now be developed based on soil and tissue test results that are presented here and other factors that may be present in this test site.

Table 3. Leaf tissue standards for peach leaves.*

Element	Short	Optimum	Excess
Nitrogen	3.00	3.00-3.50	3.7
Potassium	1.25	1.50-2.50	2.50
Calcium	1.35	1.35-1.50	?
Magnesium	0.25	0.35-0.50	0.50
Boron	---	---	---
Copper (ppm)	5	7-10	10
Manganese (ppm)	25	90-110	110
Zinc (ppm)	15	25-50	50

* SHORT: usually requires corrective measures; deficiency symptoms should be seen. OPTIMUM: the nutrient-management program currently in use is adequate to maintain nutrient levels required for current tree and crop-load conditions. EXCESS: amount of nutrient applied should be reduced or eliminated until future leaf-analyses indicate otherwise.

A general rule of thumb is to increase/decrease the past rate of each nutrient by 10% for each 0.1 variation from the standards given for that element. For example, the N level in our sample is 2.30%. It should be between 3.0 and 3.5%. Therefore, the rate of N applied the year of application that these tests will be based on should be at least 70% higher than that of the previous year. The harder decision to make is if the test results were 0.7 higher (4.2) rather than lower than the standard level. For apples, it commonly takes several years for N levels to decrease where test results have shown them to be very high. It may be wise to eliminate N in fertilizer applications for at least one year if the tissue tests show N levels to be 50% or more above recommended levels. These decisions also can be further complicated when

Table 4. Composition (by percent) of various fertilizers.

Product	N	P_2O_5	K_2O	Mg	Ca	B	Mn
10-10-10	10	10	10				
Ammonium sulfate	21						
Diammonium phosphate	17	50					
Urea	46						
Concentrated superphosphate		46					
Monammonium phosphate	11	48					
Potassium chloride (muriate of potash)			60				
Potassium magnesium sulfate (Sul-Po-Mag)			22	11			
Potassium sulfate			50				
Limestone (high-calcium lime)					45		
Dolomitic lime (high-mag lime)				15	10		
Gypsum					22		
Magnesium sulfate (epsom salts)				10			
Borate (fertilizer grade)						14	
Borax						11	
Solubor						20	
Manganese sulfate							32

considering predicted crop load, levels of other essential elements, and the history of that particular tree or block of trees. Once you have become familiar with your trees or orchard blocks, it becomes easier to use the above guidelines in determining the rates of nutrients that are required by your trees. Other factors that should be considered as well are soil type, amount of water in the soil, or predicted rainfall around the time you plan to apply nutrients.

Nutrient-management Plan

As described earlier in this series of articles, peaches respond best to soil-applied nutrients, and these should be applied as soon as possible in the spring. For our growing conditions, this usually means late April or even early May. Once the frost has left the ground, we usually have excessive soil moisture for some time making it difficult to apply fertilizers with ground equipment. Also, it takes a few weeks for soil temperatures to warm enough for plant roots to start functioning. Ideally, the nutrients that are needed should be applied so that when the roots are ready to start working, the nutrients are readily available. Under our growing conditions this time still is usually late April to mid-May.

An additional factor to consider in developing a nutrient management program is whether or not the crop you are fertilizing responds only to a specific form of any or all nutrient elements. For example, some plants respond to N only when it is in the ammonium form, while others prefer nitrate N. Other plants are highly susceptible to chlorine and will not tolerate K in the chloride form. With peaches, there is no evidence to show that either form of N is preferable, However, stone fruits are sensitive to chlorine. Therefore, muriate of potash (KCl) generally is not recommended for peaches. (There is some evidence, though, that muriate of potash can be applied safely if the application is made in the fall rather than in the spring.)

Often it is possible to supply more than one nutrient with only one nutrient source. It is in many instances the cheapest, easiest method of applying both these nutrients. For other elements, the reverse may be true, i.e. it is easier and may be less expensive to apply 10-

10-10 even though peaches do not require P after planting.

To develop a nutrient-management plan for your orchard rather than applying pre-mixed standard or orchard fertilizers, you should consider the points mentioned above. Also, realize that different nutrient sources are available (Table 4). Also be aware of environmental hazards and monetary loss when overapplying nutrients. Remember, too, that some nutrients can be toxic when levels become too high (for example, boron). After considering all the above, factor in cost. It may cost a little more to apply what's required, but in the long run, the financial cost may balance out, and side effects such as environmental pollution, toxicity, etc. will be avoided.

Using the information presented in this series of articles should help you formulate a nutrient management program that makes efficient use of inputs for maximum effect on your crop.

References (for the 3-article series)

Bennett, W.F. (ed.). 1993. *Nutrient Deficiencies and Toxicities in Crop Plants*. APS Press, St. Paul, MN.

Ferree, R.J. 1961. Peach Nutrition. In: *Better Crops with plant food*. American Potash Institute, Inc., Washington, D.C.

LaRue, J.H. and R.S. Jackson (eds.). 1989. *Peaches, Plums, and Nectarines: Growing and Handling for Fresh Market*. Pub. 3331, Coop. Extension, Univ. of California, Oakland, CA.

Stiles, W.C. and W.S. Reid. 1991. *Orchard Nutrition Management*. Info. Bull. 219, Cornell Cooperative Extension, Ithaca, NY.

Walker, W.V. and D.M. Glenn. 1990. Peach tree growth as influenced by grass species used in a killed-sod planting system. *HortScience* 25: 514-515.

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Tax Pointers for Farmers and Landowners in 1996 and Planning Notes for 1997

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Tax advice given below is intended as general advice and is believed to be correct. It does not substitute for a detailed review of the circumstances of an individual taxpayer by a professional tax practitioner. For more details, you and your tax adviser may wish to consult the sources referenced in the square brackets [thus] (see footnote) .

Follow Up from 1995's Tax Pointers

Neither the tax credit of $500 for each dependent child nor the reduction in long-term capital gains taxes passed into law in 1996. This perhaps illustrates the unwiseness of managing your business around future tax law changes.

New Tax Legislation

Three pieces of legislation that between them contain many tax-related provisions were enacted into law in the last year. The **Taxpayer Bill of Rights 2** establishes the office of Taxpayer Advocate, intended to assist taxpayers in resolving problems with the IRS, and provides other taxpayer protections. If you have to make installment payments, are subject to collection, or have similar dealings with the IRS, be sure that your tax preparer or attorney is fully aware of your new rights under the law. There is one minor obligation of the taxpayer: where you previously gave your name and address to a payee (on Forms W-2, 1099, etc.) you must now also include your telephone number. [Rights 2, §1201]. Changes brought about by the **Health Care Portability and Accountability Act** and the **Small Business Job Protection Act** (also known as the **Minimum Wage Increase Act**) are described below.

Health Insurance for the Self Employed

If you are a self-employed individual eligible to take a deduction for health insurance (on Form 1040 line 26, in 1995 and 1996 at the rate of 30%), then in 1997 you will be able to deduct 40% of the cost of health insurance paid for yourself and your family. The amount increases to 45% in 1998 and ultimately (by 2006) to 80%. [Health Act §311].

Medical Savings Accounts (MSA's)

Beginning in 1997, MSA's are available to employees covered under an employer-sponsored *high-deductible plan* (if the employer is a *small employer*) and to self-employed individuals. With a structure somewhat like an individual retirement account (IRA) an MSA is intended to provide funds free of taxes for medical expenses (**not** health insurance). Within limits, contributions to an MSA by an *eligible individual* are deductible from taxable income, employer contributions are excludable from income, interest earned on funds in the MSA is not taxable, and distributions from the MSA for medical expenses are generally excludable from income. The dollar limits of contributions and the terms italicized above are defined in the Act. This is a pilot program and the total number of plans that can be set up nationwide in any one year is limited. Any self-employed person or small employer not participating by December 31, 2000, loses the

right to set up an MSA. [Health Act §301].

Withdrawals from IRA's for Medical Expenses

The 10% additional tax applied to withdrawals from IRA's made before age 59.5 is now waived if the withdrawn cash is used to pay for medical expenses in excess of 7.5% of adjusted gross income, (i.e. if there is, or would be, a medical expense deduction on Schedule A of Form 1040.) [Health Act §361(a)].

Long-term Care Insurance

Beginning in 1997, long-term insurance premiums that do not exceed specified dollar limits are treated as medical expenses and deducted on Schedule A (subject to a floor of 7.5% of adjusted gross income). The eligible amount is age dependent, ranging from $200 for individuals aged 40 or less at the close of the tax year, to $2,500 for individuals aged over 70. For self-employed individuals, eligible long-term care insurance premiums are treated the same way as health insurance.[Health Act §§321-327].

S Corporations

There are many changes in laws affecting S corporations including: (a) may have 75 shareholders [SBA §1301]; (b) a small business that terminated S status before August 20, 1996 (date of enactment) may re-elect S status without the five-year wait [SBA §1317]; and (c) basis of S corporation stock acquired by inheritance is treated the same way as an inheritance from a partnership [SBA §1313]. Most changes are effective from January 1, 1997. In most cases, a small business contemplating a change to S corporation status will find that the simplicity and protection afforded by a limited liability company (LLC) makes the LLC a better option.

As an aside, a farm general or limited partnership may want to consider forming a Limited Liability Partnership (LLP). This gives a general partner essentially the same protection as a limited partner has now, while retaining the ability to exercise management control. Making a change to LLP could subject a formerly limited partner to self-employment tax. The partner might begin to participate materially in management while previously he or she did not meet the material-participation test for self-employment tax purposes. The IRS taxes LLP's and LLC's in the same way as partnerships.

FUTA Exemption Extended Permanently

For labor performed on or after January 1, 1995, the Federal unemployment (FUTA) tax exemption for alien agricultural workers is extended permanently. [SBA §1203].

Minimum Wage Increased

The minimum wage increased from $4.25 per hour to $4.75 per hour for the year beginning October 1, 1996 and will increase to $5.15 per hour beginning September 1, 1997. [SBA §2104].

Section 179 Expensing Amounts Increased

Starting January 1, 1997 there is a gradual increase in the amount of personal property used in a trade or business that can be expensed. In 1997, it is $18,000 and $18,500 in 1998, rising to $25,000 in 2003. Horses that meet the requirement of section 179(d) are eligible for expensing. Building components are not eligible (since they are not treated as personal property). [SBA §1111(a) and §1702(h)(19)]. Note that section-179 expensing is taken on a property **for the year that the property is placed in service** not for the year that it is acquired. If you have used up all or most of your section 179 amount during the year, consider purchasing equipment just before the end of the year, then waiting until next year to start using it. Take a section-179 deduction for the year *after* the year you purchased the equipment. (See also "Depreciation" below.)

Depreciation of Fruit and Nut Trees and Vines

The difference between date **purchased** and date **placed in service** is important. Example: Andy McIntosh purchased an orchard of two-year-old apple trees in 1995 and paid $20,000. He has $2,000 of pre-production expenses. The trees are expected to produce their first fruit in 1997. Andy will begin depreciating the orchard in 1997 (as long as he harvests some fruit) the year placed in service. He can use straight-line depreciation over a 10-year life under MACRS or over the alternative MACRS life of 20 years. (If he elected out of capitalizing pre-production expenses he **must** use the alternative 20-year life. [IRC §263A(d)(3)].) Note that Andy can claim up to $18,000 section-179 expense deduction if the trees are placed in service in 1997. [IRC §179(d)(1), IRC §1245(a)(3)].

Capitalization of Nursery Stock

Conflict exists on the rules of whether production costs must be capitalized or may be deducted as current expenses. Pre-productive costs of plants with a pre-productive period of more than two years must be capitalized [IRC §263A]. This is partly a question of intent. For example, it is hard to conceive that a Christmas tree would be sold after such a short period. However, if plants (e.g., ornamental trees or shrubs) have reached a marketable size and stage of development and the market value is known, then the maintenance costs are currently deductible. Other than for Christmas trees, current deductibility of costs would seem to apply to every plant produced by a nursery.

Sale of Farm with Retained Use of the Home

Selling a principal residence while retaining the right to live there (a retained life estate) precludes you from claiming the exclusion for gain of sale of a principal residence. Example: Florence Hadley, a 70-year-old widow, sold her farm, including the house, but retained the right to live in the house for the rest of her life. The fair market value of the house at $150,000 exceeded the basis at time of purchase. Florence has a taxable capital gain. She has the right to use and benefit from the property without paying rent. The sale of a principal residence, for purposes of claiming the capital-gains exclusion, is accomplished only when the benefits and burdens of ownership are transferred to the purchaser. [Roy vs. Commissioner, T.C. Memo 1995-23 (January 18, 1995)].

Optional Self-employment Tax for Farmers

You may have a very small amount of self-employment income. However, you might want to report more farm income than you actually made, in order to qualify for certain social-security benefits, to claim credit for child-care or dependent expenses, or to increase the amount of earned-income credit. You would use the farm-optional method of reporting self-employment income.

A **materially participating** farmer can elect to use the farm-optional method if either (a) taxpayer's gross farm income is $2,400 or less, in which case the taxpayer can report 2/3 of the gross farm income as net farm self-employment income or (b) taxpayer's gross farm income exceeds $2,400 but net farm profits are less than $1,733, in which case taxpayer reports $1,600 as net farm self-employment income. The election can be used an unlimited number of times. [IRC §1402 (a)]. The provisions allow a taxpayer to earn up to two quarters of coverage per year for social security purposes. (In 1996, $640 of net self-employment income is required to earn one quarter of coverage). Check your past employment history to see whether or not you need the two quarters of coverage to be **currently insured** or **fully insured** or both. Within the social-security system, to receive retirement benefits, you must be fully insured. To receive disability benefits, you must be currently insured. To receive survivor's benefits or lump-sum death benefits, you must be either fully insured or currently insured. To

be fully insured you must have either (a) 40 quarters of coverage (exceptions for workers born before 1929) or (b) one quarter of coverage for each year the worker is over 21 (not counting the year of death), with a minimum of 6 quarters. To be currenly insured, if you are aged less than 24 years, you must have six quarters of coverage in the preceding three years. If you are between 24 and 31, you must have one quarter of coverage for each half year over age 21 (example: if aged 26, 26-21=5 years, requires 10 quarters coverage). If you are 31 or older, you must have 20 quarters in the preceding 10 years.

Example: John Grower had been farming since 1988. Although he had gross profits in some years and losses in others he and his tax preparer had followed a tax planning strategy that enabled John to report net farm losses for every year. John was killed in a tractor accident in July 1996, leaving a wife and two young children. He was 32 years old. John never elected the optional farm method of reporting self-employment income, consequently he had no quarters of social security coverage on the day he died. His wife and children do not appear to be eligible for survivor's benefits. However, if the 1996 return will show a net farm income of at least $2,560, then four quarters of SE coverage are available under option (a). By amending John's returns from 1993 to 1995 (years whose statute of limitations for amendment has not expired) and using option (b), $1600 of net farm income can be reported each year, giving two quarters of coverage for each of those years for a total of 10 quarters of coverage. This is just the amount needed to provide for full coverage (from age 22 to age 31, using full coverage method (b)). Note: if the accident had left John permanently disabled, he would receive no disability benefits from social security since he cannot obtain the 20 quarters of coverage needed to be fully insured.

Employment Taxes for Farm Labor

Almost every farmer who employs a worker for more than a few months a year (except for harvest workers paid by piecework) will be subject to FICA taxes and to federal-income-tax withholding. A farmer who in any quarter employs the equivalent of about four full-time workers must also pay FUTA.

If total payroll in a year exceeds $2,500, all wages, except those paid at piecework rates for harvest, are subject to FICA taxes. The employer must withhold 7.65% from employees wages and also contribute 7.65% employer share. (There are exceptions for an employee paid over $62,700).

An employer must also withhold income tax unless wages are exempt from FICA. The withholding amount should be calculated from information given by each employee on form W-4 or, failing that information, at the highest (emergency) rate.

If employment taxes are less than $500 in a year, the entire amount may be paid with the employment tax return (Form 943). If employment taxes are more than $500 and less than $50,000 in the lookback period (the calendar year two years prior to the current year) payment is monthly. If more than $50,000, deposits must be made twice a week.

Footnotes

[Health Act], Health Care Portability and Accountability Act (H.R. 3103, enacted as Public Law 104-191 on August 21, 1996); [IRC], Internal Revenue Code; [Rights 2], Taxpayer Bill of Rights 2 (H.R. 2337, enacted as Public Law 104-168 on July 30, 1996); [SBA], Small Business Job Protection Act, also known as the Minimum Wage Increase Act (H.R. 3448, enacted as Public Law 104-188 on August 20, 1996); [T.C. Memo], Tax Court Memorandum.

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Fruit Notes

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